CIVIL ENGINEERING

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consists of concrete river section and fill wing dams, near Sacramento, Calif. See article by F. Kochis and H. A. Johnson.

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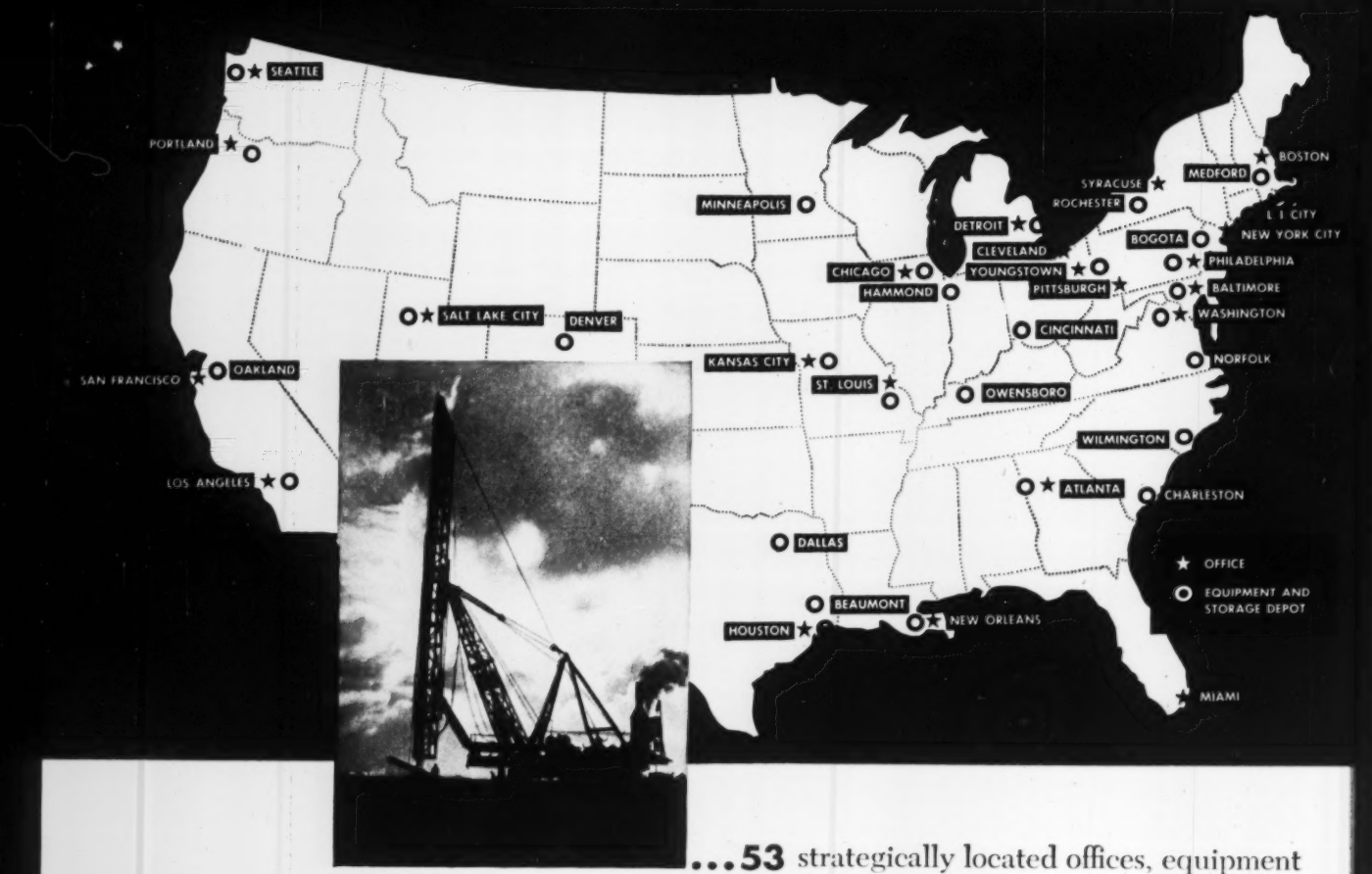

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CIVIL ENGINEERING

OCTOBER 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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$80,000,000 construction for Plattsburg jet bomber base

Rugged yellow machines and engines help speed 3,882,500 cu. yds. of excavation for 10,000-ft. runway and other projects

Matched Caterpillar equipment saves seconds every cut—a D8 push-loads a high-speed, big-capacity DW21 in sandy clay.

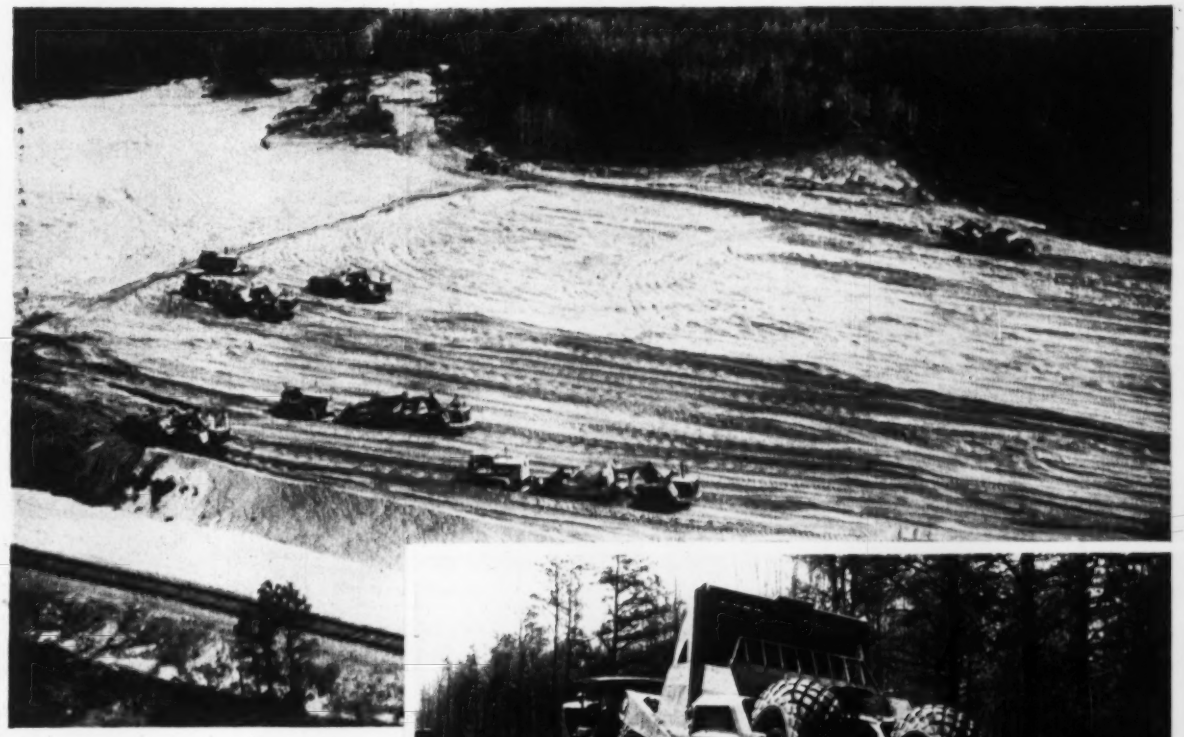
Operator's clear view of blade and job in the No. 12 helps speed shaping and leveling fill, also building road.

Keeping on schedule is the order of the day, every working day, on the $80,000,000 Air Force Base project, Plattsburg, N. Y. Construction involves clearing, leveling and paving a 10,000-ft. runway, taxiways and parking apron, relocating two miles of single-track railroad as well as building hangars, barracks, offices, jet fueling plant and water and sewage facilities. When the base is activated in the fall of 1955, a Strategic Air Command jet bomber wing of forty-five B-47s and twenty KC-97 tankers will be stationed here.

The historic site of Plattsburg Barracks, one of the oldest military installations in the United States, is the scene of hustling activity under the supervision of the Corps of Engineers. To maintain schedule (operating two 8-hour shifts per day), contractors are relying heavily on rugged yellow track and wheel-type tractors, scrapers, bulldozers, motor graders, engines and other specialized earthmovers—standardization that is paying off in all phases of the project.

Working on construction of the runway, taxiways and apron, which involves 3,410,000 yds. of excavation, Dutcher Construction Corporation, Queenstown, Md., has a fleet of fifteen DW21s, eighteen D8s and five No. 12s. Fill is 27 ft. at the deepest point. Hauls vary from 1800 ft. to 6100 ft. one way, with the DW21s averaging 18 cu. yds. of very sandy clay per load. A D4600 Engine powers a shovel piling brush for burning, while two D3400 Electric Sets provide electricity for night lighting.

On another phase of the project, laying 63,000 ft. of 38-in. drain pipe, Winkelman-Tompkins-Jones, Plattsburg, prime contractor, is using a D8,



a PD4 Pipe Layer, a No. 6 Shovel, an HT4 Shovel and a D13000 powering an excavator. Working on the hangar area, C. D. Perry & Sons, also of Plattsburg, is employing seven D8s, four No. 80 Scrapers, one D7, two D4s and three DW20 Tractors with Scrapers. The Frederick Raff Co., Inc., is using two D8s and Scrapers and a D6.

Concerning performance, D. J. Dutcher, vice president of his outfit, says: "It has been my experience that Caterpillar* equipment is more dependable and stays on the job better than any other make. The complete line of Caterpillar-built machines offers me the right equipment for every job. Wherever I go, I find it backed up by good parts and service." Charles Wilber, superintendent for C. D. Perry & Sons, reports: "Because of their low maintenance cost, ease of operation, dependability, excellent service and parts facilities and ability to operate in any weather, I am very well satisfied with our Caterpillar units."

Standardizing on CAT*-built equipment has other advantages, too. Many parts are interchangeable, cutting down time and parts inventory. Operators and machinists, familiar with one make of machinery, get more work out of it. And the nearby Caterpillar Dealer provides time-saving, money-saving one-stop service whenever needed. See him—ask him to show you how you'll profit more by standardizing on Caterpillar equipment.

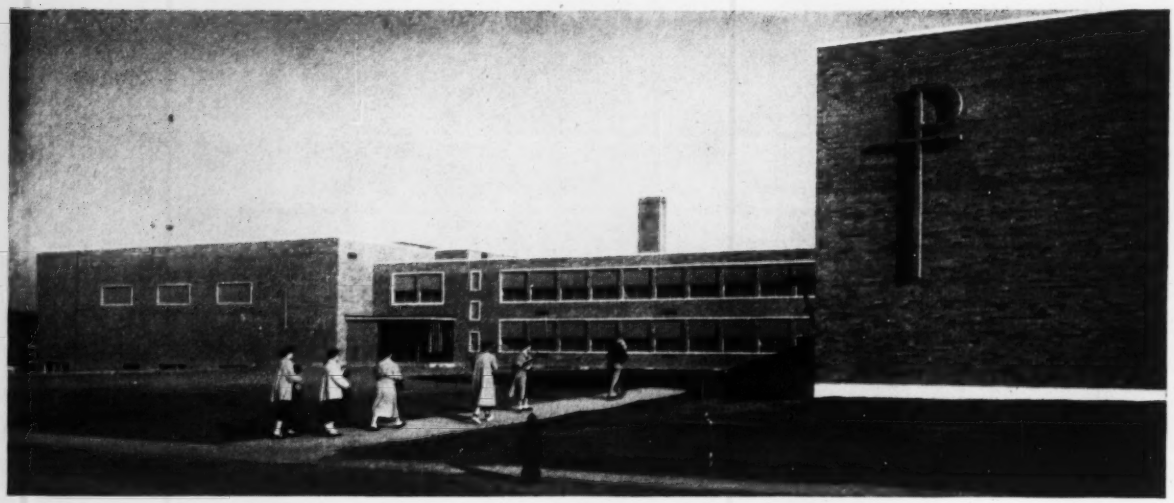
Building access road, D8 with No. 80 Scraper handles 20 cu. yds. a load on 1200-ft. one-way hauls.

Piling brush for burning, this shovel gets dependable, low-cost power from its honestly rated Cat D4600 Engine.

Versatile Cat HT4 Shovel backfills trench, while a D4 with PD4 Pipe Layer (not shown here) lays 38-in. pipe.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

*Both Cat and Caterpillar are registered trademarks—®



Lehigh Cements were used throughout this new school. Lehigh Early Strength Cement for the second floor concrete. Lehigh Portland Cement for all other concrete. Lehigh Mortar Cement for all masonry.

- **ST. REGIS PAROCHIAL HIGH SCHOOL,** Eau Claire, Wis.
- Contractor: **PETERSON CONSTRUCTION COMPANY,** Minneapolis, Minn.
- Architect: **E. F. KLINGER & ASSOCIATES,** Eau Claire, Wis.
- Dealer: **A. J. AIRIS COMPANY,** Eau Claire, Wis.

Lower costs...early completion

with **LEHIGH EARLY STRENGTH CEMENT**

How can you get the jump on competition, finish jobs ahead of schedule, save time and money? One way is to use Lehigh Early Strength Cement.

The experience of Peterson Construction Company on the St. Regis Parochial High School is a good example. An early completion date helped them get the job. A fast construction schedule—one that included the use of Lehigh Early Strength Cement—made it possible to complete the job ahead of the penalty date. School opened on time.

Lehigh Early Strength Cement was used for pouring the second floor in severe winter weather. Form costs were cut 30%; curing costs 70%; general overhead 20%. Time saved added up to six weeks!

Try Lehigh Early Strength Cement on *your* next winter job. It will help you speed operations, cut costs.

LEHIGH PORTLAND CEMENT COMPANY
ALLENTOWN, PA.

Placing concrete made with Lehigh Early Strength Cement. Pouring of second floor concrete moved right along regardless of winter weather.

Peterson Construction Company "have been using Lehigh Mortar Cement satisfactorily for brick work, block, tile, glass block and stone" for many years ... in all kinds of weather.

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- Precisely fabricated panels make installation easier, faster.
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- Irving reputation of over 50 years of customer satisfaction is your guarantee of effective grating application.

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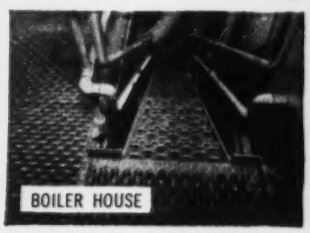
Non-skid; fireproof

Strong; self-draining



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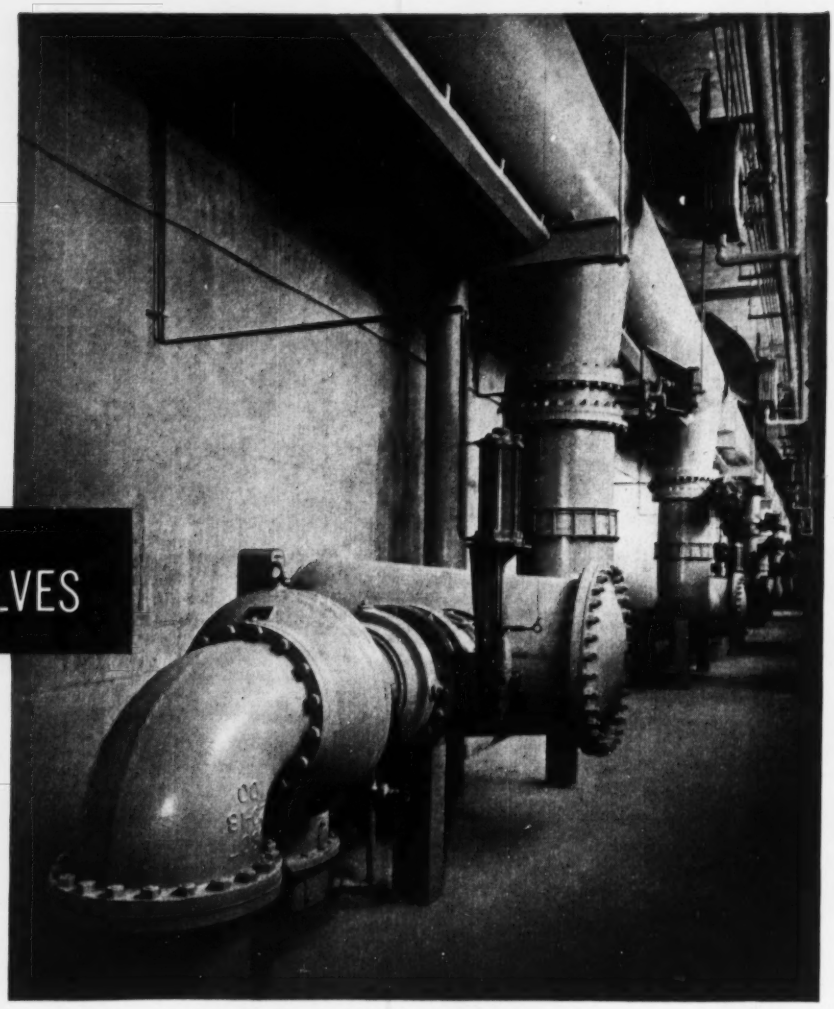

R-S
BUTTERFLY VALVES

San Jacinto Project uses 65 large R-S Butterfly valves

CITY OF HOUSTON SAVES $124,000 with DROP-TIGHT RUBBER-SEATED VALVES

Choosing R-S Rubber-Seated Butterfly Valves* enabled Freese, Nichols & Turner, Consultants on the San Jacinto River project, to save $124,000 for the City of Houston. Use of 65 of these valves for all low-pressure service gave a substantial space reduction and the direct, in-place cash savings over gate valves. SMS cone check valves were also chosen for pump discharge service.

Positive closure in R-S Rubber-Seated Valves is obtained by wedge-type closure of the disk within a one-piece rubber seat. Tough, flexible rubber seals the entire disk seat – including the area around the shaft bosses. Supervised testing of a six inch R-S Rubber-Seated Valve proved that after 6,000 closings the valve was still giving positive shutoff at 100 psig water.

These valves are the product of over 75 years of design and engineering experience in the hydraulics field. To find out more about our complete line—R-S Butterfly, Rotovalves and Ball Valves – write to S. Morgan Smith Company, York, Pennsylvania.

**Approved and accepted by the A.W.W.A., Seattle Convention, 1954.*

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SMS

IH ON THE SUPER HIGHWAYS

Carving out the West Virginia Turnpike

INTERNATIONAL PAYSCRAPERS and crawlers help contractors carve 88 mile roadway through mountainous terrain.

With the opening of the new West Virginia Turnpike, travel distance between Charleston and Princeton shrinks from 110 to 88 miles, a 20% reduction in mileage over a two-lane road that makes driving through the mountains faster and far safer.

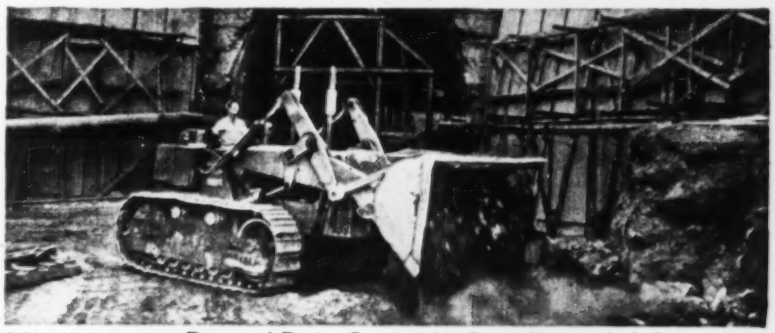
While not as long as some of the other new Turnpikes, this $96,000,000 road-building venture was a rugged test for contractors from the outset with original estimates of 25,000,000 cubic yards of earthmoving increased by mountain slides that required moving more than 500,000 yards of dirt for each mile of highway built in many locations.

This mountainous setting provided contractors with more concrete evidence that INTERNATIONAL tractors—both rubber-tired and crawler—really pay off big when the chips are down . . . when greater power, payload moving capacity and maneuverability are needed in the tight spots.

It takes just 10 seconds to get the low-down on International's greater earthmoving earning power. Simply call your International Industrial Distributor today and he'll demonstrate any of the great INTERNATIONAL tractors with matched equipment right on your job tomorrow.

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

A MOUNTAIN SLIDE nearly doubled the excavation work of the L. S. Coleman Company, St. Albans, West Virginia, in Kanawha County, but two INTERNATIONAL TD-24s and two INTERNATIONAL 2T-75s helped remove the slide in short order.



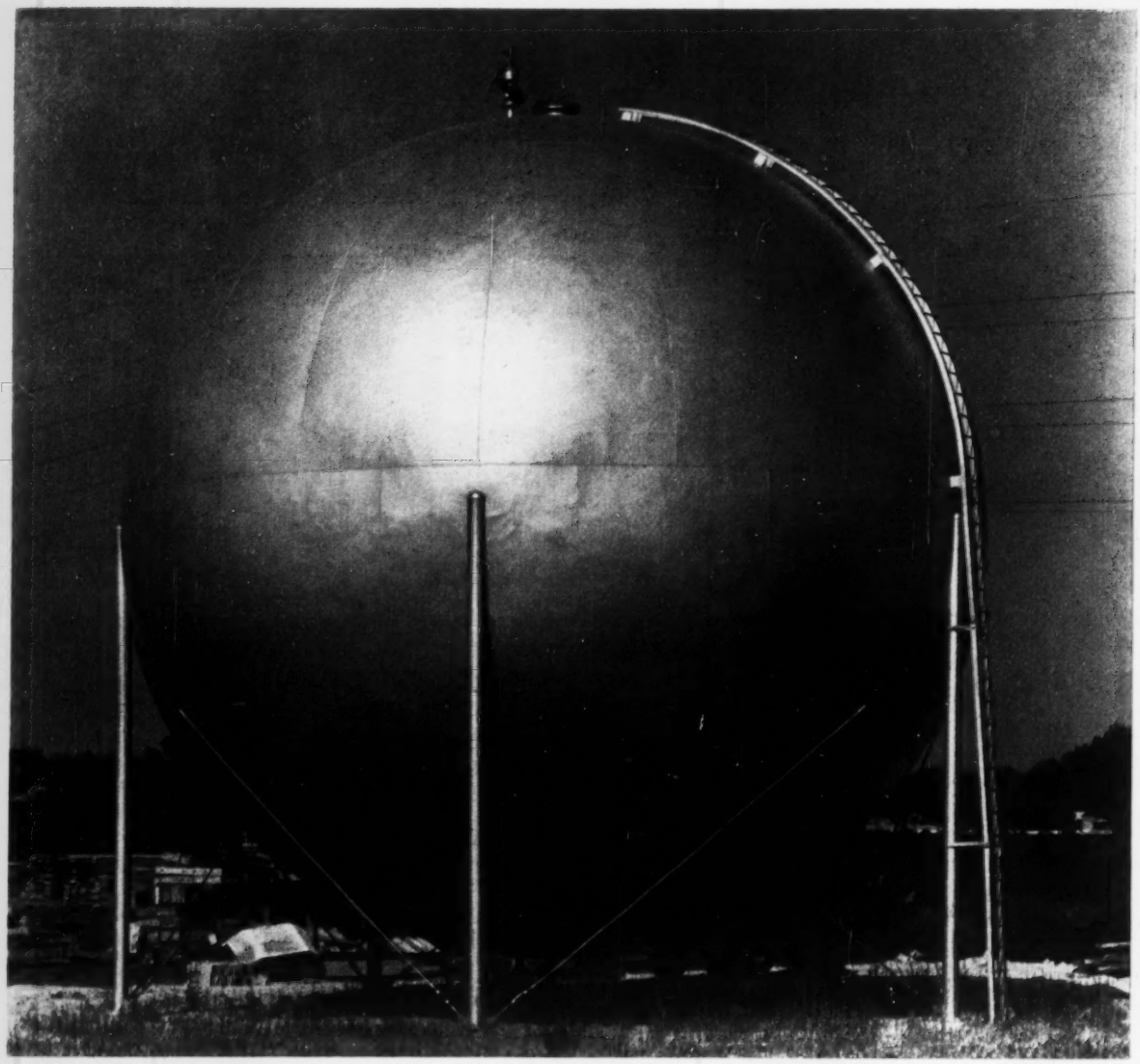
TITAN IN A TUNNEL. Bates and Rogers Construction Corp., Chicago, find the INTERNATIONAL TD-18A crawler and 3 cu. yd. DROTT Skid-Shovel a great all-around performer in constructing half-mile tunnel between Standard and Fairfield, West Virginia.

LATROBE LIKES 'EM. *"We put our 3 TD-24s on the tough jobs because of the extra power and speed, their all-around efficiency and stamina,"* says John Sobotta, grade foreman for Latrobe Road Construction Co., Latrobe, Penn., contractors on 3,000,000 cubic yards of excavation and embankment in Raleigh County.

INTERNATIONAL HARVESTER

INTERNATIONAL

FOR EVERY MOVE IN EARTHMOVING



Hortonsphere means new economy at Sludge Plant

Consoer, Townsend and Associates, consulting engineers, for the Benton Harbor-St. Joseph, Michigan, sewage treatment plant, report the following on the 40-ft. diam. Hortonsphere® built by CB&I at the plant.

". . . All digester gas produced at this plant is used in gas engines driving raw sewage pumps and air blowers for the activated sludge process. With the engines demanding gas at a uniform rate, and the digesters producing gas at a variable rate, storage was necessary. The 91,000-cu. ft. Hortonsphere was installed to provide the storage and permit continuous engine operation and economical use of the gas produced. In effect, the Hortonsphere floats on the supply line to the gas engines. Any gas produced by the digesters at a rate higher than engine usage is pumped to the sphere. When the demand for fuel is higher than digester production, gas flows through pressure reducing valves from the Hortonsphere to the engines.

"The gas system Hortonsphere and engines went into operation as designed and have operated very satisfactorily to date."

Hortonspheres for digester gas or municipal gas service are built in sizes up to 80 ft. in diam. for working pressures up to 75 lbs. per sq. in. Write our nearest office for further information, estimates or quotations.

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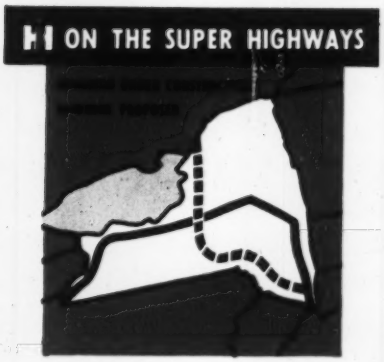

Pushing Completion of New York Thruway

Contractors get big assist from INTERNATIONAL TD-24s as $823 million super road enters final construction stage.

The New York Thruway is now a year from completion . . . 427 miles long with four authorized extensions totaling another 128 miles . . . $823 million projected construction cost . . . approximately 80,000,000 cubic yards of rock and stone to be moved.

Road builders on the Thruway from New York City to Buffalo have banked on INTERNATIONAL TD-24s to keep them on schedule . . . clearing the right of way . . . pulling bigger scraper loads faster than any other crawler . . . pushing elevating loaders . . . push-loading like no other crawler can . . . leveling and compacting fills.

Whether you handle big Thruway contracts or do custom work, your International Industrial Distributor is the fellow for you to call today for demonstration proof of how the complete INTERNATIONAL line of nine crawler and rubber-tired tractors can cut your costs.

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

250 LOADS IN 10 HOURS is the production pace maintained by these 3 TD-24s and scrapers for the Savin Construction Corp., Hartford, Conn., on one of four contracts the firm has on the Thruway in Greene County. Savin uses 7 TD-24s to move 6 million cubic yards.

SUPT. RATES TD-24s TOPS. "*Our* INTERNATIONAL *TD-24s and scrapers deliver paydirt faster than any others on the job—usually more than 100 loads each in 10 hours,*" says J. P. Connor, superintendent for Smith Construction Company, Pelham, N. Y., subcontractors of 1,500,000 cubic yards of earthmoving.

BEARCATS IN THE BORROW PIT are these two INTERNATIONAL TD-24s used by Arute Brothers, Inc., New Britain, Conn., on two Thruway prime contracts totaling $3,082,905 in Monroe County. Four TD-24s are used for push-and-pull loading and for leveling the fill.

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INTERNATIONAL®

FOR EVERY MOVE IN EARTHMOVING

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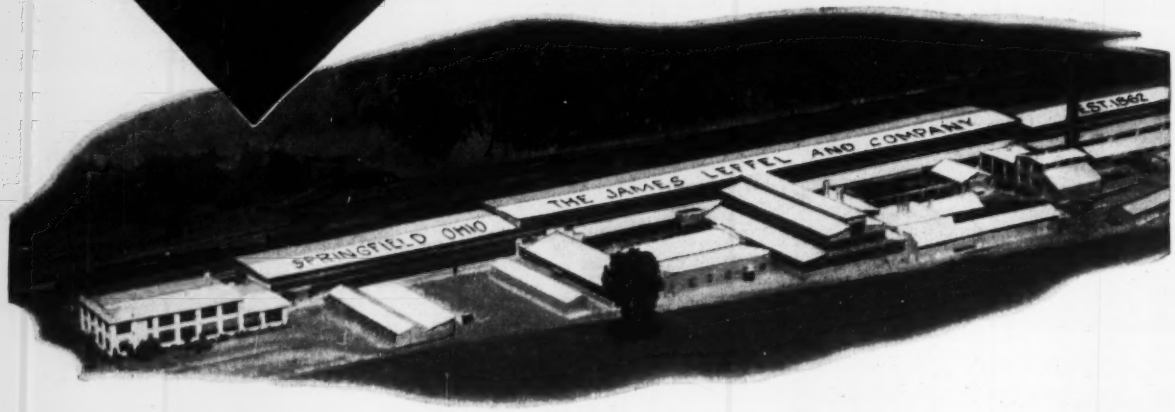
Hydraulic Turbines

. . . a mark of quality for 92 years



During the course of 92 years many reputations are made and destroyed, many companies rise and fall. Only by the sheer weight of integrity in every phase of its performance of duty can a company win and hold the approval of those with whom it does business.

If, through such a period of time, there is no moment of weakness in the determination to maintain the finest standards of engineering and production, the company will be, today, in the best position in all its history to serve its customers.

It takes time to judge an hydraulic turbine. Quality, or the lack of it, may not be fully apparent for a brief time — yet day after day, year after year, the turbine rewards or penalizes the buyer. **Price or promise may sell, but only integrity can deliver.** As time goes on, the conscientious turbine builder finds himself with widening opportunities to serve.

Not once during 92 years has Leffel yielded to the temptation to lessen its prestige for the sake of a cheaper product to meet competition. And so, because the service that a company renders over the years is a basic ingredient in its reputation, especially in a long-time investment such as that in an hydraulic turbine, hydraulic turbine buyers entrust their water-power problems to Leffel **with complete confidence.**

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Leffel vertical and horizontal shaft hydraulic turbines on our assembly floor.

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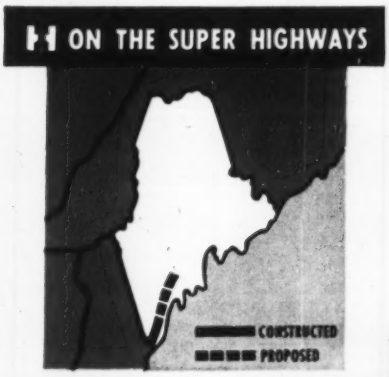


Extending the Maine Turnpike

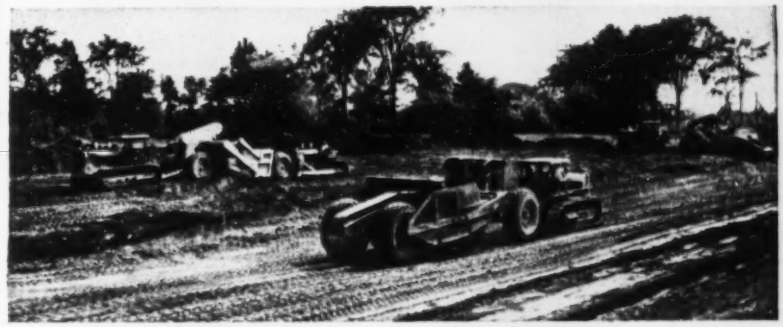
Contractors using fleets of INTERNATIONAL TD-24 crawlers to complete 67.5 mile Portland to Augusta addition

With traffic on the present Maine Turnpike running 10 years ahead of estimates, the pressure is on to complete the 67.5-mile Maine Turnpike Extension from the Portland by-pass to the outskirts of Augusta.

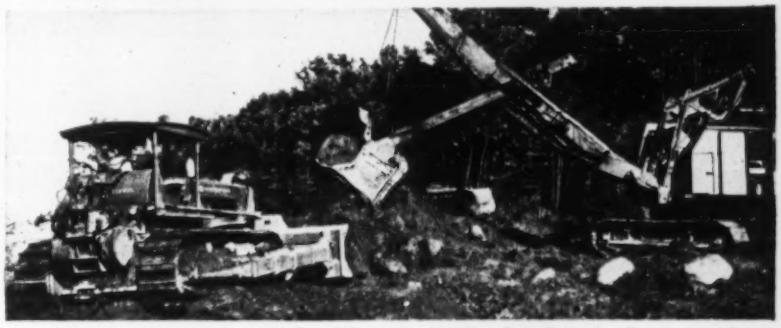
And contractors all along the Turnpike Extension are off-setting a six weeks' delay due to rain in early summer by using fleets of big 155 drawbar horsepower INTERNATIONAL TD-24 crawlers to make the dirt fly . . . hauling dense scraper loads . . . push-loading as no other crawler can . . . towing 50-ton compactors . . . every bulldozing job on the right of way from pioneering to finish grading.

Match the production of these INTERNATIONAL earthmovers against your present equipment tomorrow by calling your International Industrial Distributor today for your on-the-job demonstration.

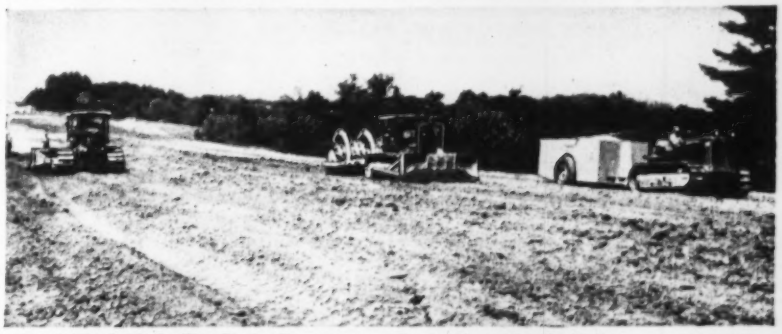
INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS



DIGGIN' IN FOR DEMATTEO. *"After six weeks of rain it's mighty nice to see our TD-24s delivering 24 cubic yard payloads to help us get back on schedule"* reports F. L. Kirby, superintendent for DeMatteo Construction Company, Quincy, Mass. Eight TD-24s are on the job.



PACIN' THE BIG DIPPERS. Latrobe Road Construction Co., Inc., Latrobe, Penn. uses three TD-24s on its subcontract with Savin and Supt. F. E. Crowell states, *"The TD-24 is the only crawler, bar none, that's been able to keep ahead of our big shovel operations".*

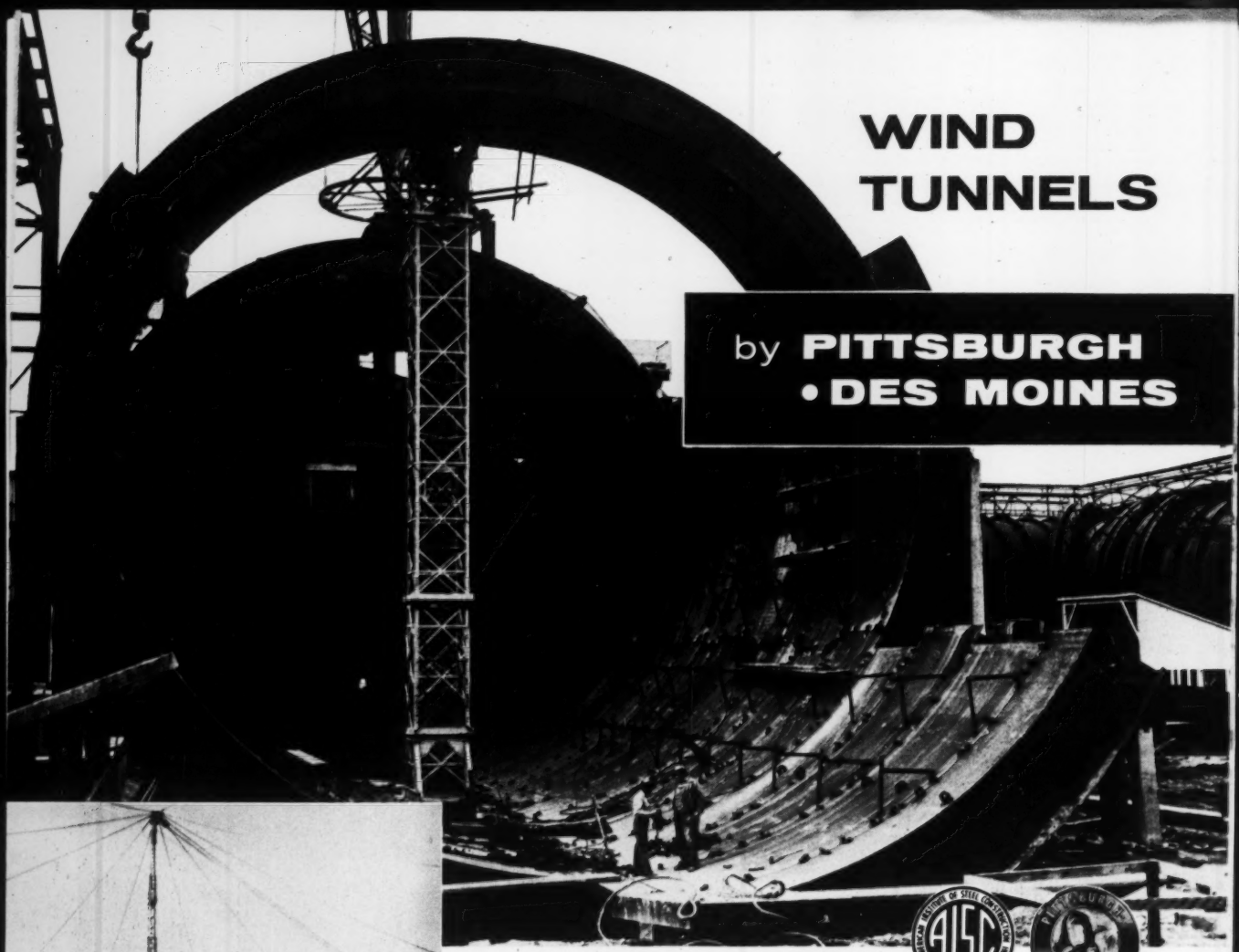


IT'S TD-24s 9 TO 5. The Savin Construction Corp., East Hartford, Conn. uses 9 INTERNATIONAL TD-24s on its 10.585 section of the Turnpike to move 2,000,000 cubic yards of earth and 90,000 cubic yards of rock. Three TD-24s shown compacting a fill near Portland.

INTERNATIONAL HARVESTER

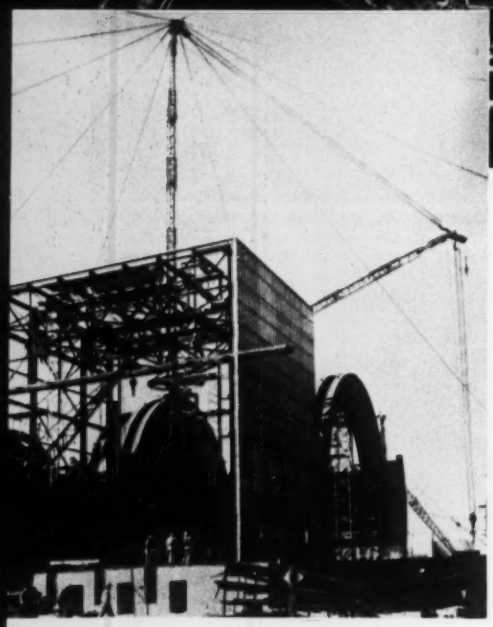
INTERNATIONAL®

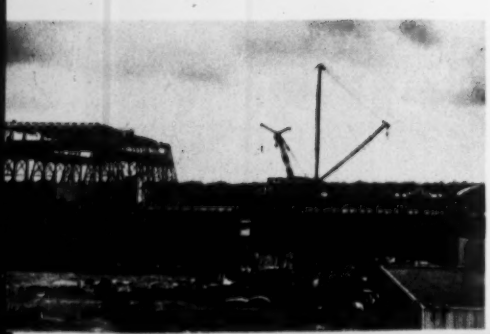
FOR EVERY MOVE IN EARTHMOVING



WIND TUNNELS

by PITTSBURGH • DES MOINES





. . . progress report on

Tullahoma

With plate construction more than 90% complete, mighty Tullahoma is now a massive, hollow rectangle of heavy steel covering several acres. In a matter of months, Arnold Engineering Development Center will have in this Tennessee facility the greatest instrument for high-speed aeronautic research ever produced. • Employing plates from one to six inches thick, the tunnel sections require advanced techniques in field welding, matching in accuracy P-DM's precision shop fabrication. Speeding the work at every stage is the unrivalled experience of Pittsburgh-Des Moines in building wind tunnels of every type for government and private industry.

PITTSBURGH•DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

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NEWARK (2),....251 Industrial Office Bldg.
CHICAGO (3), 1274 First National Bank Bldg.
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DES MOINES (8),.....971 Tuttle Street
DALLAS (1),.....1275 Praetorian Building
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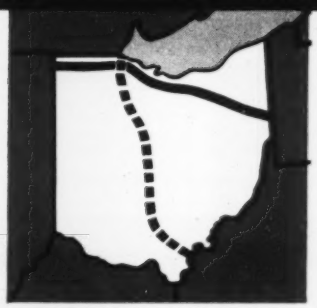
SANTA CLARA, CAL.,.. .....677 Alviso Road

IH ON THE SUPER HIGHWAYS



UNDER CONSTRUCTION
PROPOSED

Opening up the Ohio Turnpike

HEAP LOADS IN A HURRY. One of Julian Construction Company's seven TD-24s push-loads a new INTERNATIONAL 2T-75 two-wheel, rubber-tired tractor near Wauseon, Ohio. Julian has 1,000,000 cubic yards of dirt to move in sub-grading 7.2 miles of the Ohio Turnpike.

LOADING IN MAHONING COUNTY. Two of D. W. Winkleman's five TD-24s complete fast cycles in spite of soggy going south of Youngstown. Roughly three-and-a-quarter million cubic yards will be moved on this contract.

SPEEDS SOIL-STRIPPING FOR SMALLEY. Approximately 3,600,000 cubic yards of earth will be moved by D. R. Smalley and Sons, Celina, Ohio. One of their three TD-24s is used to pull a loader in the borrow pit near Milan, Ohio.

INTERNATIONAL TD-24 crawler tractors preferred by contractors on toughest phases of Ohio Turnpike construction

An estimated 29,506,100 cubic yards of earth and rock is being excavated and an estimated 46,905,000 cubic yards of borrow and fill will be moved before the great new 241.1 mile Ohio Turnpike is completed.

All along the Ohio Turnpike, from the eastern terminus in Mahoning County to the western terminus in Williams County, INTERNATIONAL TD-24 crawler tractors are taking over the toughest earthmoving jobs.

With 155 drawbar horsepower, the INTERNATIONAL TD-24 can conquer any big job. And the durability of every TD-24 means less maintenance, downtime, and operating expense, more profit for owners.

For full details or an on-the-job demonstration with the TD-24 or any of the other six great INTERNATIONAL crawlers and two rubber-tired tractors with scrapers or bottom dump wagon, call your International Industrial Distributor today.

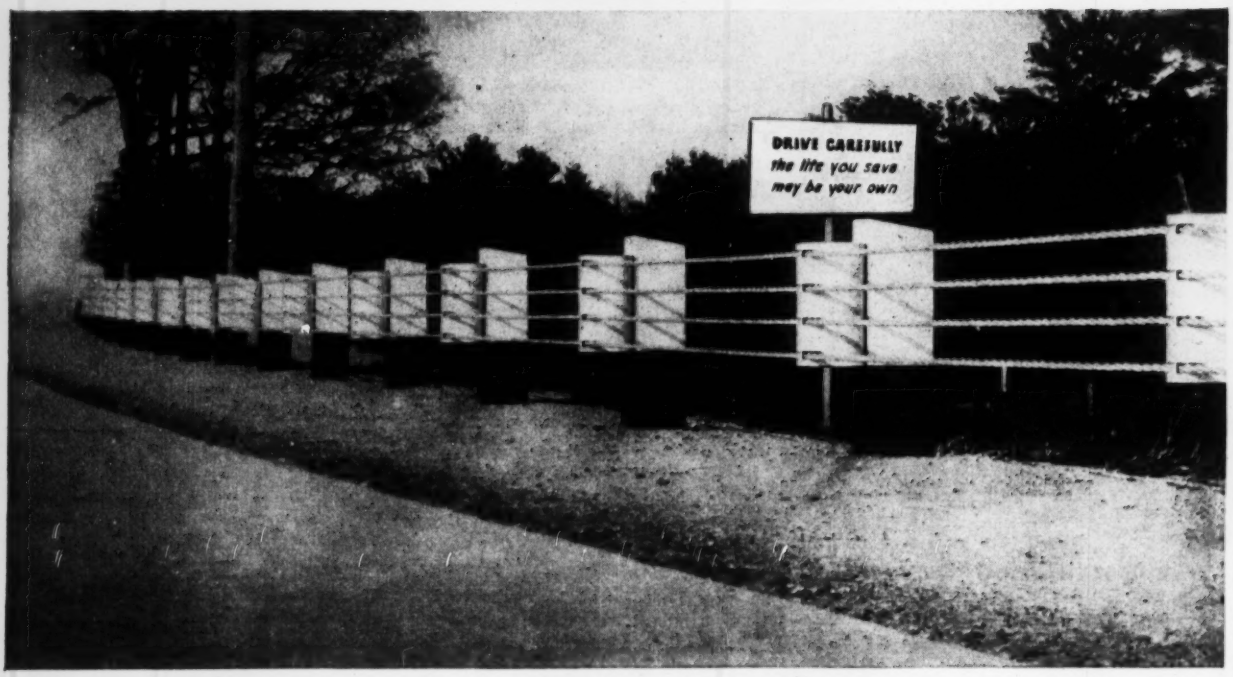
INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

INTERNATIONAL HARVESTER

INTERNATIONAL®

FOR EVERY MOVE IN EARTHMOVING

Proved Protection with Amergard



EASY INSTALLATION and maintenance make Amergard a low-cost highway guard. No skilled labor and few tools are required. Properly installed, Amergard stays attractive, resists corrosion and weather.

at High Speeds
Highway Cable Guard

WE took no chances when we designed Amergard Highway Cable Guard. We made actual tests—sent automobiles hurtling into experimental guards of all types—and only then got down to the important business of designing a highway guard.

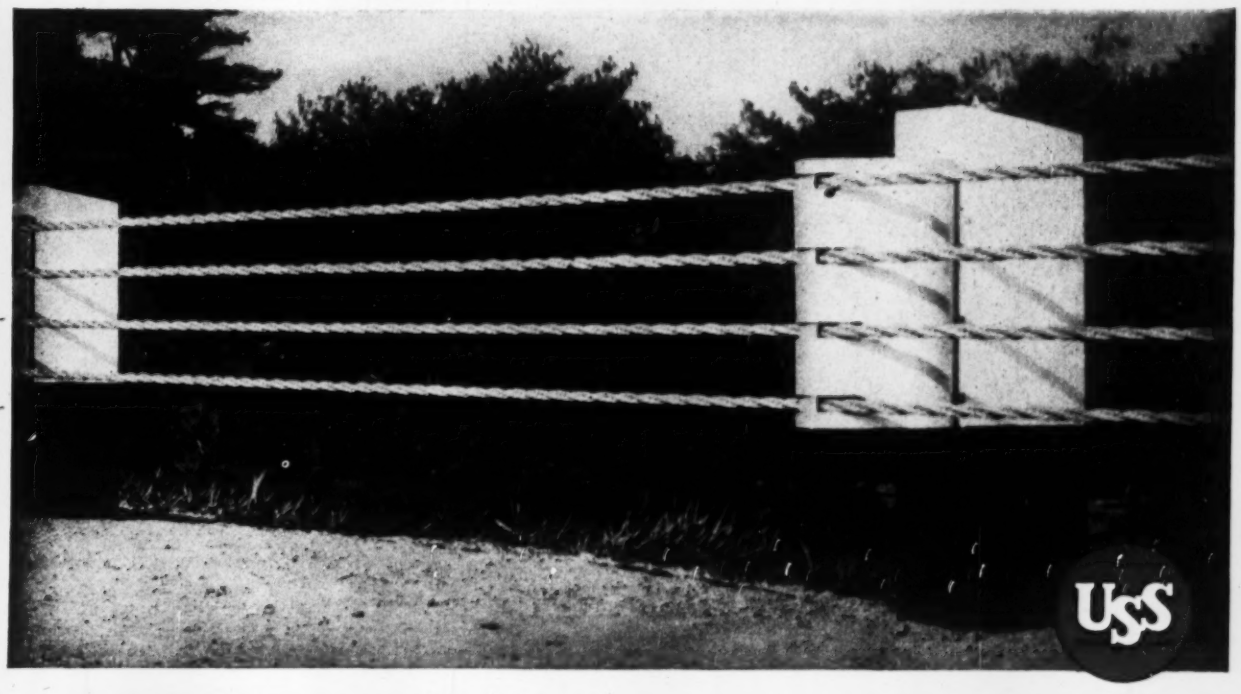
Results of over 140 of these impact tests prove that Amergard, which is made of strong *flexible* steel cables, gives greater protection to automobiles and passengers than any other type of highway guard.

Amergard gives *double-action* cushioning. First you have the inherent flexibility of the cable acting to cushion the shock of a collision, and, second, you have special spring-steel offset brackets that add extra shock absorption.

Amergard's special features make it possible to design the safety of your highways to suit a given rate of speed. Three-cable, 75,000-lb. Amergard provides adequate protection for speeds of 55 mph or less. Four-cable, 100,000-lb. Amergard provides adequate protection up to about 75 mph. Remember, these are the speeds at the point of impact with the cable. It's safe to assume that a car would have to be going *much faster* on the roadway to achieve these speeds at impact.

Our engineers will be glad to help you plan the safety guard on your next highway. They can give you expert advice on both design and installation. Write for complete information.

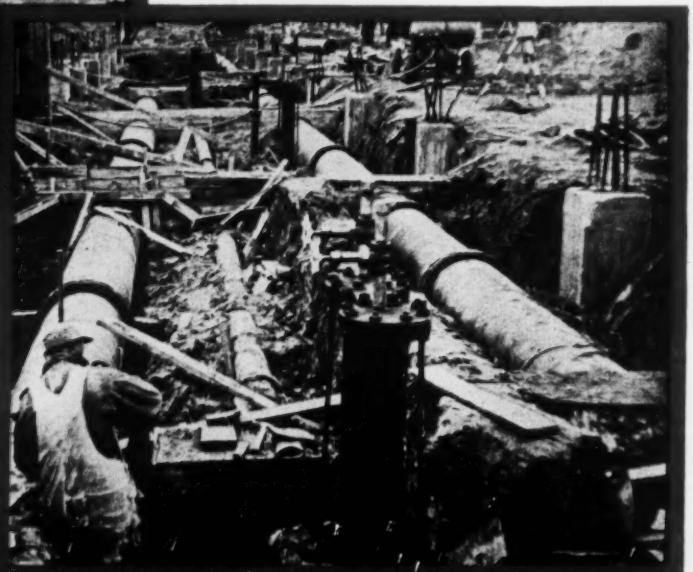
AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL CORPORATION, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK



UNITED STATES STEEL

Used on jobs

When an installation, once completed, should be as trouble-proof as planning and materials can make it—engineers rely on cast iron pipe. It has high beam-strength, compressive-strength and shock-strength. Its effective resistance to corrosion ensures long life, underground or underwater. These are reasons why cast iron pipe is so widely used for water lines in tough terrain, pressure and outfall sewers, river crossings, and encased piping in sewage treatment and water filtration plants. For further information write: Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.



(above)
Cast iron mechanical joint pipe installed in connection with a new, larger sewage treatment plant at Rochester, Minn.

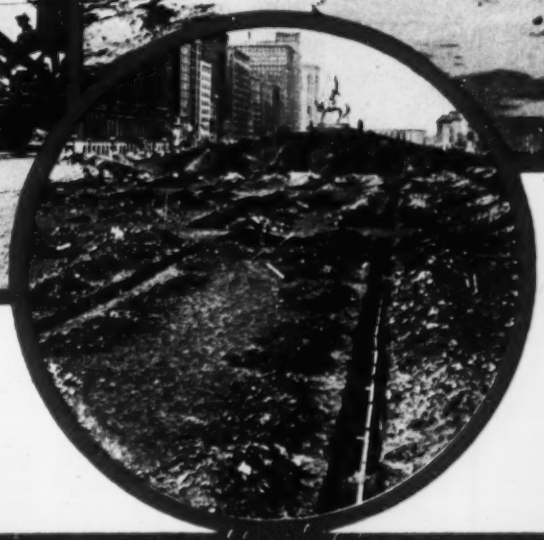
(at right)
Installing cast iron mechanical joint pipe used in air-conditioning system for Northland Shopping Center, Detroit, Mich.

CAST IRON PIPE

where long life is a "must"

(top right)
Installing large diameter cast iron pipe across Willamette River at Portland, Oregon for sewer line to interceptors and to new disposal plant.

(below)
Seven miles of 16-inch mechanical joint cast iron pipe installed for gas main in New Jersey.



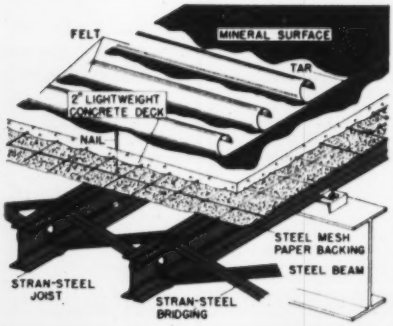
(at right)
Installation of cast iron pipe for irrigation and sprinkling system for a Chicago park.

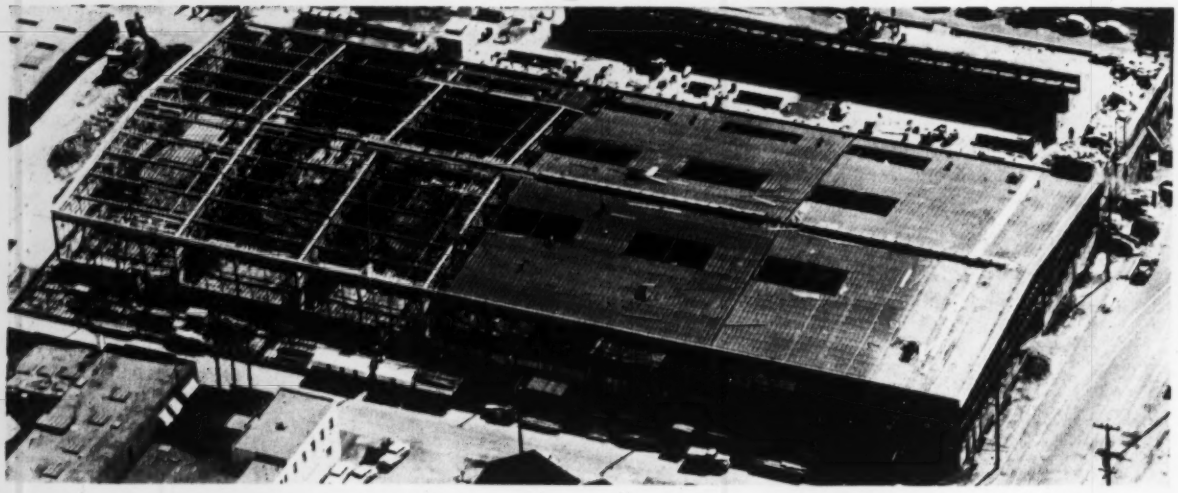
SERVES FOR CENTURIES...

Reduce Roof Weight

with Nailable Stran-Steel® Purlins

for pitched or flat roofs





40 per cent reduction in roof weight of San Francisco's Pacific Greyhound Terminal was possible by using Stran-Steel Purlins and lightweight concrete deck.

The building covers seven acres and makes use of nailable Stran-Steel studs, joists and purlins throughout. Designers: Skidmore, Owings and Merrill.

LIGHTWEIGHT: Easy to handle and place.

NAILABLE: Special groove deforms and clinches nails in a grip of steel. Use ordinary carpenter's tools. Saves field costs of clips and attachments.

ECONOMICAL: Easily and quickly erected by welding or sheet metal screws. Use of Stran-Steel members speeds completion by providing factory-punched clearance holes for plumber's pipe and electrician's conduit. Entire building can be framed and closed in without costly interruptions.

VERSATILE: Stran-Steel framing comes in standard depths, gauges and lengths. Can be used with all types of decking collaterals.

AVAILABLE: On-the-spot distributors and dealers in all major building centers.

FREE—Write for detailed information about Stran-Steel Framing and its application to all types of buildings. (See your Sweet's Catalog Insert.)

GREAT LAKES STEEL CORPORATION
Stran-Steel Division — Ecorse, Detroit 29, Michigan
NATIONAL STEEL CORPORATION

PRODUCER OF NAX HIGH-TENSILE STEEL

OUR INTEGRATED OPERATION PERMITS MAXIMUM CONTROL OF QUALITY

Ore and Coal Mines

Coke Ovens

Blast Furnaces

Pipe Plants

U.S. cast iron PIPE

FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

From start to finish, our wholly integrated operation makes it possible for us to control quality at every step. Beginning with our mines, quarries and blast furnaces. Ending with our modern casting machines and laboratories.

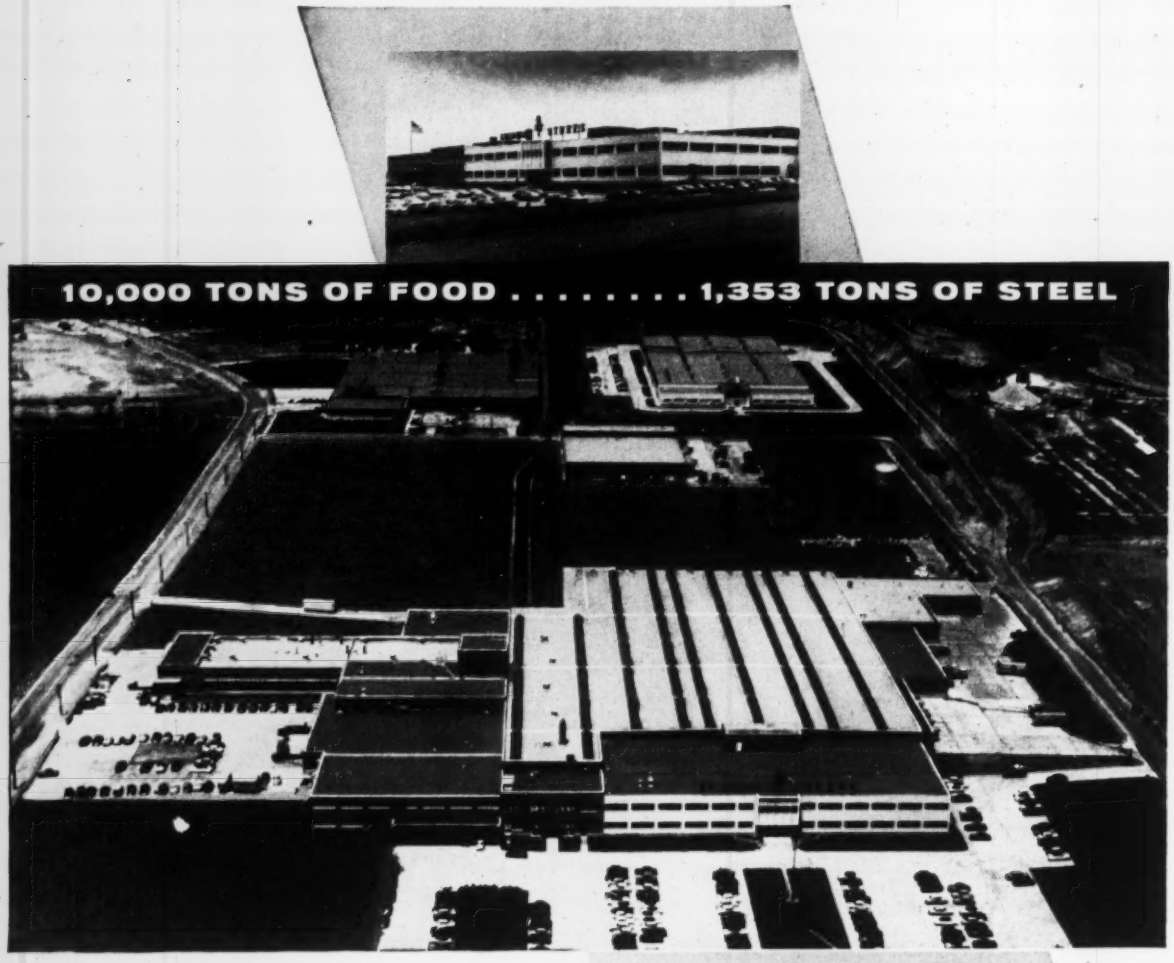
Responsibility for quality rests squarely on the shoulders of a wholly integrated producer. He shares that responsibility with no one.

In addition to being able to control the quality of pipe-making raw materials at their sources, our Quality Control of pipe production gives further assurance to customers that the quality level of U. S. Cast Iron Pipe is in excess of standard specifications. Our pipe is produced to our own quality control specifications, more exacting than the established specifications under which cast iron pipe is normally purchased.

U. S. PIPE & FOUNDRY COMPANY

GENERAL OFFICES: BIRMINGHAM 2, ALABAMA

A wholly integrated producer . . . from mines and blast furnaces to finished pipe.



COLONIAL STORES HEADQUARTERS in Atlanta is the hub of the largest food chain in the Southeast

Fabricating Steel is our Business

Ingalls, the nation's leading independent steel fabricator, supplied 1,353 tons of fabricated steel for Colonial Stores' offices and warehouse in Atlanta. The tremendous warehouse has a capacity of 10,000 tons of food.

Countless numbers of commercial and industrial buildings, built during the past 40-odd years in almost every section of the country, are proof that Ingalls can meet your fabricated steel requirements, regardless of size or location. Plants at Verona (Pittsburgh district), Pa., Birmingham, North Birmingham, Pascagoula, Miss., and Decatur, Ala., assure *you* prompt, efficient and economical service.

FOR COMPLETE INFORMATION WRITE:

The INGALLS Iron Works Company

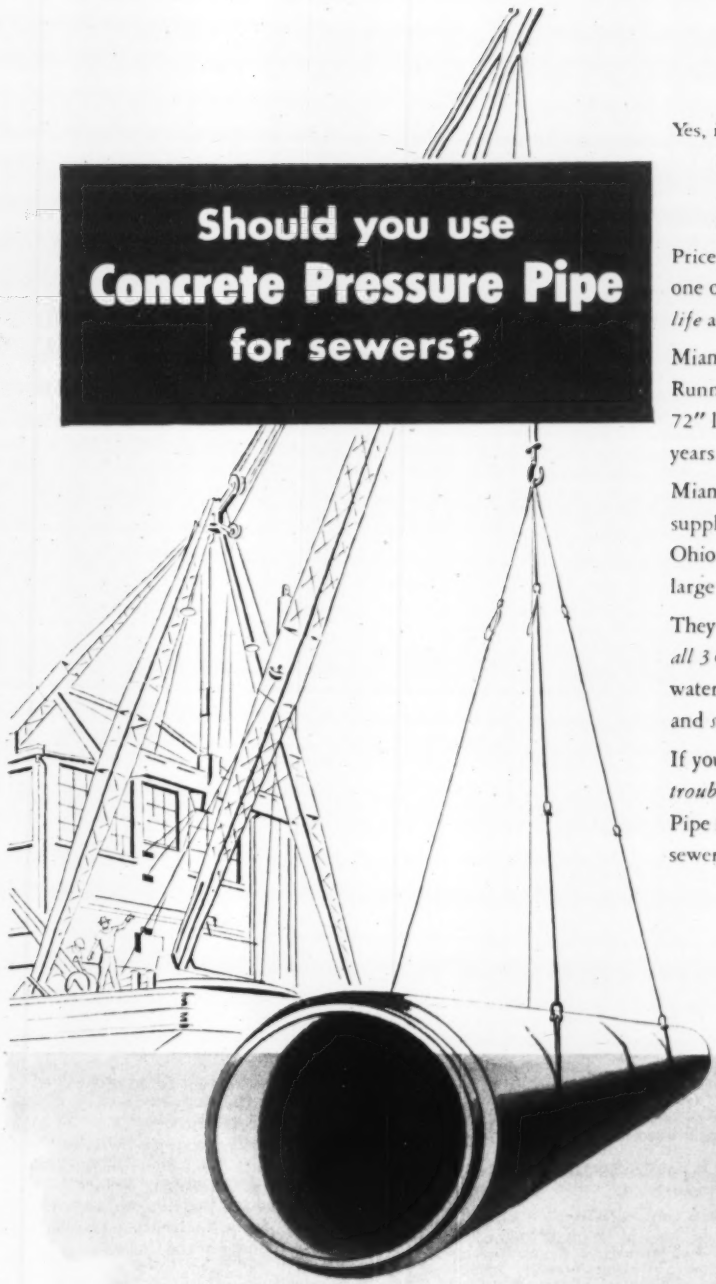
BIRMINGHAM, ALABAMA

SALES OFFICES: New York, Chicago, Pittsburgh, Houston, New Orleans
PLANTS: Birmingham, Ala., Verona, Pa., North Birmingham, Ala., Pascagoula, Miss., Decatur, Ala.

Fabricated Steel for:

Power Plants • Hangars • Grandstands • Bridges • Office Buildings
Churches • Stores • Apartments
Theaters • Hotels • Hospitals
Schools • Industrial Buildings • Tanks
Pressure Vessels • Bins • Stacks

Should you use Concrete Pressure Pipe for sewers?



Yes, if you have one of these three jobs to do:

Sewer force main

Anti-infiltration sewer line

Subaqueous sewer line

Price Concrete Pressure Pipe is ideal for any one of these because it has *great strength, long life* and *flexible, bottle-tight joints.*

Miami's new subaqueous sewer line is Price Pipe. Running across the bottom of Biscayne Bay, this 72" line of ageless concrete will give scores of years of trouble-free service.

Miami uses Price Concrete Pressure Pipe for water supply lines, too. So do Rochester, N. Y., Xenia, Ohio, Saginaw, Michigan, and many other cities, large and small.

They like Price water pipe because it gives them *all 3* of the "Big 3" requirements for an ideal water supply line . . . *long life, great strength* and *sustained capacity.*

If you want the *permanence* of concrete, plus *trouble-free service,* specify Concrete Pressure Pipe for your next water supply or pressure sewer line.

Price Brothers Company

1820 East Monument Ave.
Dayton 1, Ohio

Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

NEWS OF ENGINEERS

Reuben Hayes retired on September 1 as engineer of bridges for the Southern Railway System after 43 years of continuous service. He had held the post of engineer of bridges for the past twenty years.

Walter H. Lobenstein, Jr., civil engineer of Los Angeles, announces his association with **Roy Donley,** architect, with offices at 8810 Melrose Avenue, Los Angeles 46, Calif. Mr. Lobenstein was recently released from naval duty.

C. A. Trexel, Rear Admiral, CEC, USN (ret.), recently became associated with the Tudor Engineering Co., of San Francisco, as a partner in the firm. Earlier Admiral Trexel was executive manager of the International Marine Platform Contractors, San Francisco.

Vaughn E. Hansen, on leave from his position as research associate professor of irrigation engineering at Utah State Agricultural College, is in Angola, West Africa, as assistant chief engineer for the Hydrotechnic Corp., on studies of irrigation and hydroelectric potentialities of the Quanza, Lucala and Bengo rivers. Mr. Hansen is a junior partner in the firm of Israelsen and Hansen, consulting engineers, of Logan, Utah, and president of Ades, Inc. (Agricultural Development and Engineering Services). He is this year's winner of the Collingwood Prize for Juniors for a paper on "Unconfined Ground-Water Flow to Multiple Wells," in the 1952 TRANSACTIONS.

Joseph H. Senne, Jr., formerly assistant professor of civil engineering at the Missouri School of Mines, is now on the Iowa State College faculty in a similar capacity.

William A. Fortune, structural engineer for the Tennessee Valley Authority, Knoxville, is now associated with **David B. Leiberman,** Knoxville architect.

Donald P. Schiesswohl, sanitary engineer in the Bureau of Sanitary Engineering of the Florida State Board of Health, at Jacksonville, recently became associated with the Federation of Sewage and Industrial Wastes Association. He was named to the newly-created post of executive assistant in the headquarters staff at Champaign, Ill., and as assistant editor of the federation's journal, *Sewage and Industrial Wastes.*

T. C. Forrest, Jr., partner in the firm of Forrest & Cotton, consulting engineers of Dallas, Tex., was presented the honorary degree of doctor of engineering by Southern Methodist University during the past commencement season.

Thorndike Saville, dean of New York University's College of Engineering, has been named president general of the Fifth International Congress on Coastal Engineering, held September 8–11 at the University of Grenoble, France. Dean Saville attended the congress as a representative of the Engineering Foundation. He was a founder of the Council. Attending the meeting as a representative of the Department of the Army was **Robert Y. Hudson,** chief of the Wave Action Section of the Waterways Experiment Station.

Thorndike Saville

Robert Y. Hudson

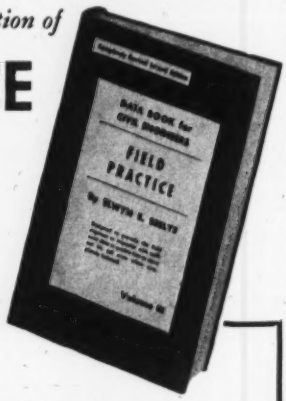
Just out! The New Revised 2nd Edition of

FIELD PRACTICE

Volume III of

DATA BOOK for CIVIL ENGINEERS

By ELWYN E. SEELYE



Brought up to date and widened in scope, this new second edition of *Field Practice* is almost an entirely new book. It gives the field engineer or inspector all the basic data he needs, on almost every branch of civil engineering, in one convenient pocket-size volume! It tells *what* has to be done and shows *how to do it.*

The material is arranged for quick and easy reference. Each section opens with a full list of items that must be checked in any given job. These are followed by detailed instructions for the check procedures involved and discussions of special problems which may be encountered. Finally, in each section, there is a collection of data and general background information, including essays that provide a compact general experience of what to expect in a wide variety of conditions and situations.

NEW in this 2nd Edition:

- **Latest testing rules set up by such organizations as A.S.T.M., A.C.I., A.I.S.C A.A.S.H.O., and P.C.A.**
- **Illustrations on different types of pilings and new data on all types**
- **Practical methods of field erection, including equipment**
- **New information on common types of cracking and other masonry defects**
- **New tables on the corrosion of metals, including the galvanic series**
- **Methods of identifying steel and iron by means of sparks**
- **A discussion of soil behavior including a simplification of soil mechanics**
- **Detailed provisions for the inspector's personal safety**
- **Summary of tests for airport construction**
- **Greatly expanded sections on concrete and on timber**

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Part II. SURVEYING. Topographic Survey. Construction Stakeouts. Circular Curves. Transition Curves. Vertical Curves. Railroad Turnouts and Crossovers. Earthwork Computations. Leveling. Transit Problems. Allowable Errors. Determination of True North. Instruments and Their Adjustments. Taping. Mapping. General Tables and Information.

Vol. III FIELD PRACTICE, 2nd Edition 394 pages
1954 5 x 8¼" Illustrated $7.50

Vol. I DESIGN, 2nd Edition 521 pages
1951 9⅛ x 11¼ Illustrated $12.00

Vol. II SPECIFICATIONS AND COSTS, 2nd Ed. 506 pages
1951 9⅛ x 11¼" Illustrated $14.00

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JOHN WILEY & SONS, Inc.

440 Fourth Avenue **New York 16, N. Y.**

William A. Griswold recently accepted a position as liaison engineer with the Avco Division of the Crosley Corp., at Nashville, Tenn. Mr. Griswold has been working as a civil engineer for the Tennessee Valley Authority.

Paul A. Smith retired from the Coast and Geodetic Survey on August 31, following 30 years of service. At the time of his retirement he was on special assignment to the Assistant Secretary of Defense for Research and Development. He is the recipient of the 1954 Department of Commerce Gold Medal. Mr. Smith was a leader in the establishment of the International Civil Aviation Organization and has held many special assignments.

George M. Garrett, deputy state highway engineer and freeway engineer-manager for the Texas State Highway Department, retired on July 1 and is planning to enter private practice.

Edward E. Bigelow was recently appointed assistant engineering manager of the Stone & Webster Engineering Corp., Boston, Mass. Connected with the firm since 1923, Mr. Bigelow has been structural engineer on company projects throughout the country.

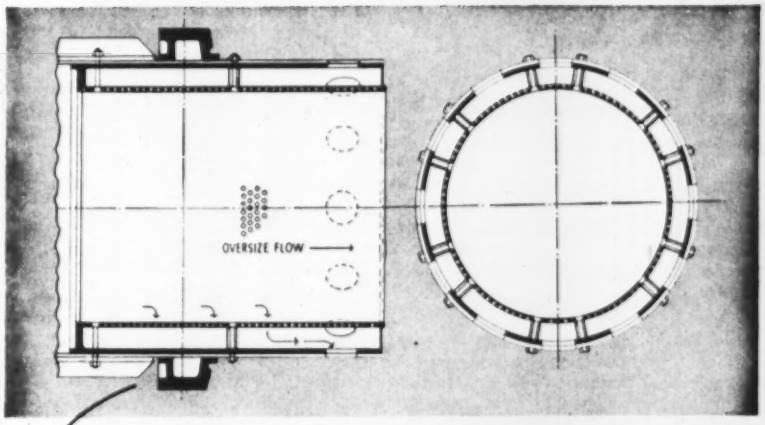
Peter A. Strobel, of the New York firm of consulting engineers, Strobel and Salzman, has been appointed commissioner of the Public Building Service in the General Services Administration. The company's practice will be under the direction of **Joseph Salzman.**

Alex C. Kelley has been named manager of the Atlantic Steel Company's fabricating division, at Atlanta, Ga. Mr. Kelley has been engineer in the fabricating division since 1953 and was previously connected with the N.C. & St. L. Railway. In his new capacity he will direct the company's sales of fabricated reinforcing bars, welded wire mesh, and accessories to the construction field.

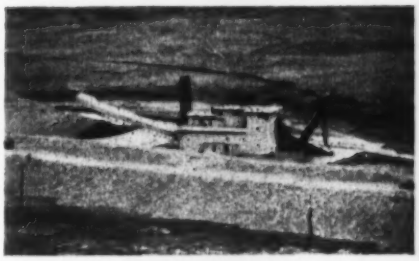
Lawrence A. Lane has been appointed head of the Oakland (Calif.) Building Department, replacing the recently retired **Milton P. Kitchel.** Mr. Lane has been an Oakland city employee since 1941.

Paul D. Haney has joined the staff of Black & Veatch of Kansas City, Mo., and will be active in matters pertaining to water supply, water purification, sewerage, sewage and trade waste disposal, and other sanitary problems. Until recently Mr. Haney was sanitary engineer director of the Robert A. Taft Sanitary Engineering Center, U.S. Public Health Service, Cincinnati.

(*Continued on page 26*)



First Olson trommel was built for and job proved on this YUBA 8 cu. ft. dredge, Goodnews Bay Mining Co., Platinum, Alaska.



Increase Your Screening Area Without Lengthening Screen

✓ Use YUBA-built Olson Dredge Trommel on either old or new revolving screens

Now, increase screening capacity as much as 25% without lengthening your screens, with the new Olson patented dredge trommel.

Here's how: Olson dredge trommel mounts inside present revolving screens in the area usually blanked out by circular tread rings and blank end plates. Its perforated holes convert this blank space into an inner screening area that: (a) greatly increases screening capacity or (b) provides better classification of screened material through smaller perforation sizes.

Coarse material goes out the end, as in any conventional revolving screen; but fines pass through the perforated holes of the Olson trommel onto the blank shell plate; then through large holes to join fines from the forward screening area.

✓ Order from YUBA

Edward Olson developed and proved this trommel in Alaska. YUBA now has manufacturing rights under the Olson patents, and makes these trommels of ARS plate, with taper drilled holes to size and spacings you need.

Get full use from your screen; order YUBA-built Olson trommels NOW. Send detail and general arrangement of screen, hole size and spacing, for estimates. No obligation.

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News of Engineers

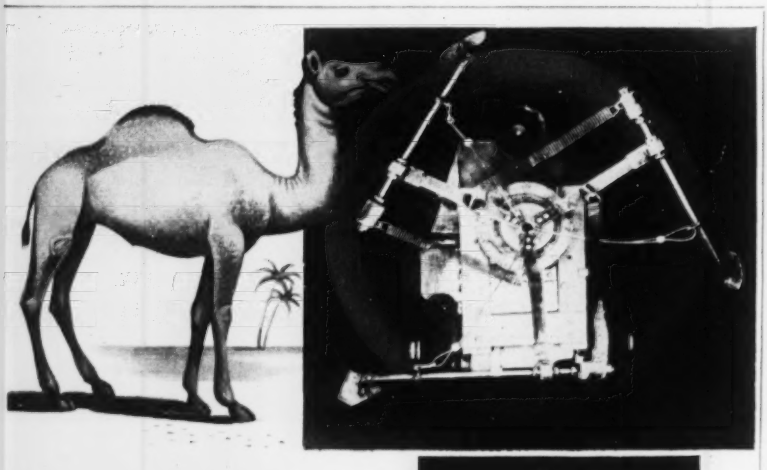
(Continued from page 25)

Charles W. Thomas, hydraulic engineer on the staff of the chief engineer of the U.S. Bureau of Reclamation, returned to Denver, Colo., on August 1 after spending six months in the Philippines on assignment for the Foreign Operations Administration. Mr. Thomas served as a consultant on hydraulic problems to the National Power Corp., and the National Economic Council of the Philippine government.

Sol Pincus, consulting sanitary engineer of New York, will present a paper on the "Problems of Sanitation and Engineering in the Underdeveloped Areas of Italy," at the International Congress on Underdeveloped Areas to be held in Milan, October 10–16.

J. Maughs Brown, chief of the road branch of the Bureau of Indian Affairs since 1941, retired on August 31 after 21 years of continuous service. His successor is **Robert J. Trier,** who has been with the Bureau since 1933—for the past eight years as assistant chief.

Russell C. Weber has joined the firm of LeRoy Crandall & Associates, consulting foundation engineers of Los Angeles, as a partner. Mr. Weber was previously office engineer for Dames & Moore, also of Los Angeles.



CENTRILINE goes to Aden

Deep in the middle east, Centriline is currently centrifugally lining 11,920 feet of salt water mains for the Anglo Iranian Petroleum Company's Aden Refinery. The mains vary in diameter from 24" to 74" and are being lined with cement mortar in thicknesses of from ⅜" to ¼". The General Contractor, George Wimpy & Co. of England and the Pipe & Erection Contractor, Bechtel International Corp. of San Francisco, selected the Centriline process for the same reasons that have made it famous across the United States . . . guarantee against interior leakage, corrosion and tuberculation . . . low pumping costs . . . and high carrying capacity. Whether old or new, when a pipe is Centrilined its life is extended indefinitely. For complete details, call on Centriline today.

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A. M. Allen recently resigned from the TVA's Design Division to join the Corps of Engineers as a structural engineer in the Tullahoma District.

Fred R. White, for 33 years chief engineer of the Iowa State Highway Commission and consulting engineer to the commission since 1952, has retired from state service.

Olcott L. Hooper has advanced from hydraulic to chief hydraulic engineer of the Stone & Webster Engineering Corp., succeeding **George R. Strandberg.** He also has been named to head the hydraulic division. Mr. Hooper joined Stone & Webster in 1947 and the following year was given the title of hydraulic engineer. Mr. Strandberg, who has been with the company since 1917, and head of the hydraulic division since 1945, will serve in the capacity of consulting engineer.

Edward J. Cleary, chief engineer and executive director of the Ohio River Valley Water Sanitation Commission, has received an award from the Interamerican Association of Sanitary Engineering for his contributions to the association's congresses, and as organizer and first president of the United States section. **Donald L. Snow,** senior sanitary engineer for the U.S. Public Health Service, was commended for his role in the establishment of a journal and in organization of the secretarial functions of the group.

Harry C. Wills, Lieutenant Commander, CEC, USN, was recently decorated by the Republic of Korea for his service as commanding officer of Seabee Maintenance Unit 1, from August 1952 to July 1953.

Ralph Weaver has left the Tennessee Valley Authority, Knoxville, where he has been serving as a hydraulic engineer in the hydraulics laboratory, to accept a position with Cook Laboratories in Chicago.

Reynolds McHenry, former manager of Leland S. Rosener Engineers, San Francisco, is now on the executive staff of Swinerton & Walberg Co., a San Francisco construction firm.

S. S. Morris, city engineer of Capetown, South Africa, presented the presidential address before the 33rd annual conference of the Institution of Municipal Engineers (South Africa District) at Durban on August 2. Mr. Morris' address was entitled "The Impact of People, Their Way of Life and Thought, on Municipal Engineering."

Eugene H. Harlow was recently promoted from vice-president to executive vice-president of Frederic R. Harris, Inc., New York consulting firm.

M. R. Wolters has been transferred from the Humble Oil & Refining Company's engineering division in Houston to the Los Angeles office, where he will serve as area civil engineer. Several other recent

changes on the Humble staff include the following: **W. A. Castille,** transferred from the Los Angeles civil engineering division to the same division at Houston as senior supervising civil engineer; **Lindsey I. Lipscomb,** transferred from the East Texas division office in Tyler, to the Southwest Texas division in Corpus Christi; **F. P. Graham,** transferred from the gas construction division office in Houston to the East Texas division office in Tyler; and **R. B. Seal,** promoted from junior to associate civil engineer in the Gulf Coast division office at Houston.

James M. Polatty has assumed duties as chief of the Concrete Branch of the Concrete Division, Jackson Sub-Office, Waterways Experiment Station, at Vicksburg, Miss. Mr. Polatty has been with the Corps of Engineers since 1941, and at the time of his transfer was serving as assistant resident engineer on the Jim Woodruff Dam near Chattahoochee, Fla.

James M. Polatty

J. S. Fink, structural engineer for Robert & Co., Associates, Inc., of Atlanta, Ga., is now principal assistant to the chief bridge engineer for Gannett Fleming Corddry and Carpenter, Inc., Harrisburg, Pa.

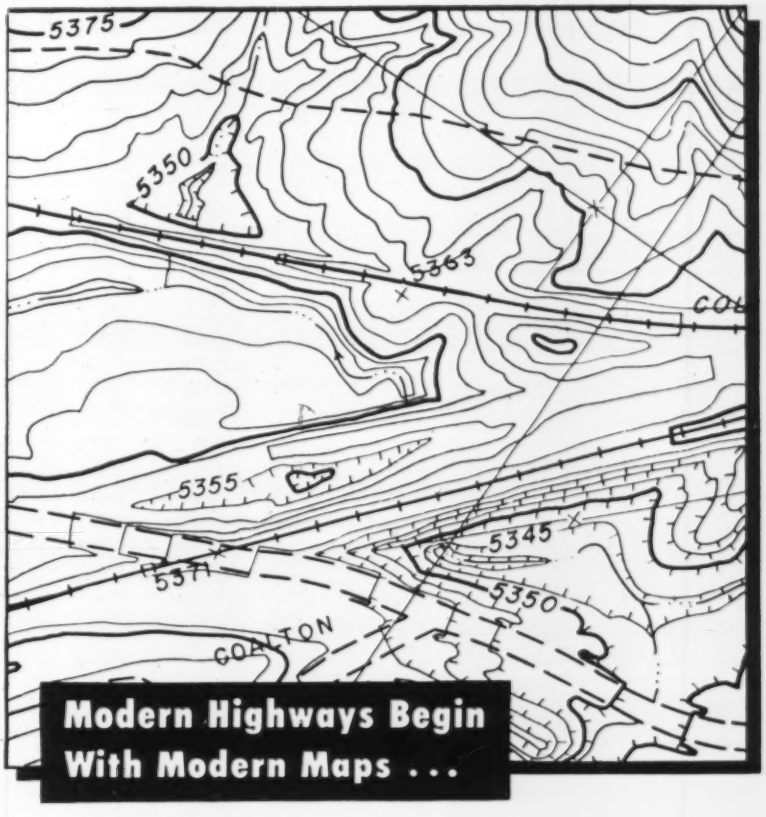
Robert E. Krucklin, former engineer with the Alvin Johnson Co., New York consultants, has become associated with the North Atlantic Constructors, contractors on the Greenland bases, as head of the materials and procurement department.

Delbert B. Freeman, Colonel, Corps of Engineers, who has served as Upper Mississippi Valley Division Engineer for the past two years, was appointed chief of the Technical Liaison Division of the Office of the Chief of Engineers, Washington, D. C., effective September 1.

Emil A. Gramstorff, chairman of the department of civil engineering at Northeastern University, has been named dean of the graduate division of the college of engineering. Professor Gramstorff's post as head of the civil engineering department will be filled by **Prof. Charles O. Baird Jr.,** a member of the faculty.

Warren N. Riker, since 1946 chief engineer for the Raymond Concrete Pile Co. in New York, has succeeded **Henry A. Mohr** as district manager for the firm in the Boston area. Mr. Mohr, who joined Raymond in 1918, served as district manager at Norfolk from 1920 to 1925 and at Boston since 1925, and will remain with Raymond in a consulting capacity.

(*Continued on page 28*)



Modern Highways Begin With Modern Maps . . .

Post-war automobile production has put more vehicles on our highways than they were ever designed to handle. More and new types of highways are vitally needed now. Freeways, turnpikes and toll roads are being planned to shorten the distances, reduce grades and reduce travel time.

Topographic maps produced by Jack Ammann photogrammetric methods— have been produced— or are now being produced for the following:

- **Denver-Boulder Turnpike**
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- **Kansas Turnpike**
- **Dallas-San Antonio Turnpike**
- **Dallas-Ft. Worth Turnpike**
- **Highway Departments of Vermont, Massachusetts, New York, Connecticut, Rhode Island, New Jersey, Kansas, Texas, California, Washington and Oregon.**

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Completed structure August 28, 1952, six months after contract was signed.

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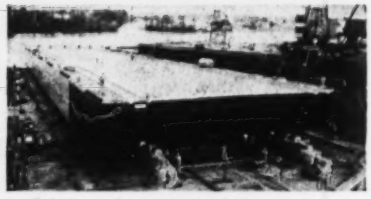
First dock section, 82' by 377' ready for launching.
Dock sections were economically fabricated at an Orange, Texas shipyard and launched for towing to dock site.



Prefabricated to required size and strength at shipyard.

MAY 21, 1952.
First dock section, arriving at site on Orinoco River, after being towed across 3,000 miles of ocean.

First section loaded with its own caissons and all erection gear and equipment required for project.

MAY 22, 1952.
Crane placing 6 ft. diam., 100 ft. long steel caissons in wells fitted with Airjacks. Crane, Airjacks and other equipment were later transferred to second and third sections for erection purposes. Elevation of dock can be regulated to 1/32 of an inch.

After caissons are placed, De Long Airjacks working simultaneously, raise dock section to desired elevation.

A week after arrival at Orinoco Mining Company's site on the Orinoco River, Venezuela, first dock section berths ship, and unloading of cargo begins. Two additional units make this pier 1,130 ft. long, 82 ft. wide, and 15 ft. deep, shown above.

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Clifford M. Hathaway, retired chief engineer and consultant for the Illinois Division of Highways, is currently engaged in research for the National Research Council of the Highway Research Board. A member of the Committee on Research for many years, he has completed a study on the curing of concrete pavements from 1935 to the present.

William T. Ingram has established a consulting practice in sanitary engineering in New York City and may be reached at his home office (20 Point Crescent, Whitestone 57, N.Y.) or his laboratory office (148 Islip Avenue, Islip, L.I., c/o South Shore Laboratories). He is continuing his association with the New York University College of Engineering as adjunct professor, and will serve as a project director for the university's Research Division on Sanitary Engineering, Industrial Health and Safety, and Air Pollution Control Research.

Albert C. Klingenberg, who has been with the firm of Baltimore Contractors Inc., for the past three years directing methods and planning and subsidiaries, has been promoted to director of engineering, planning and sales.

Murray G. Walker, engineer in the Washington State Division of Hydraulics at Olympia, has been appointed to the post of Washington State Supervisor of Water Resources.

William S. Walker has become associated with the Detroit Steel Products Co., as a sales engineer in their Pittsburgh district office. He was formerly a design engineer for the Dravo Corp., Pittsburgh, and the Treadwell Construction Co., Midland, Pa.

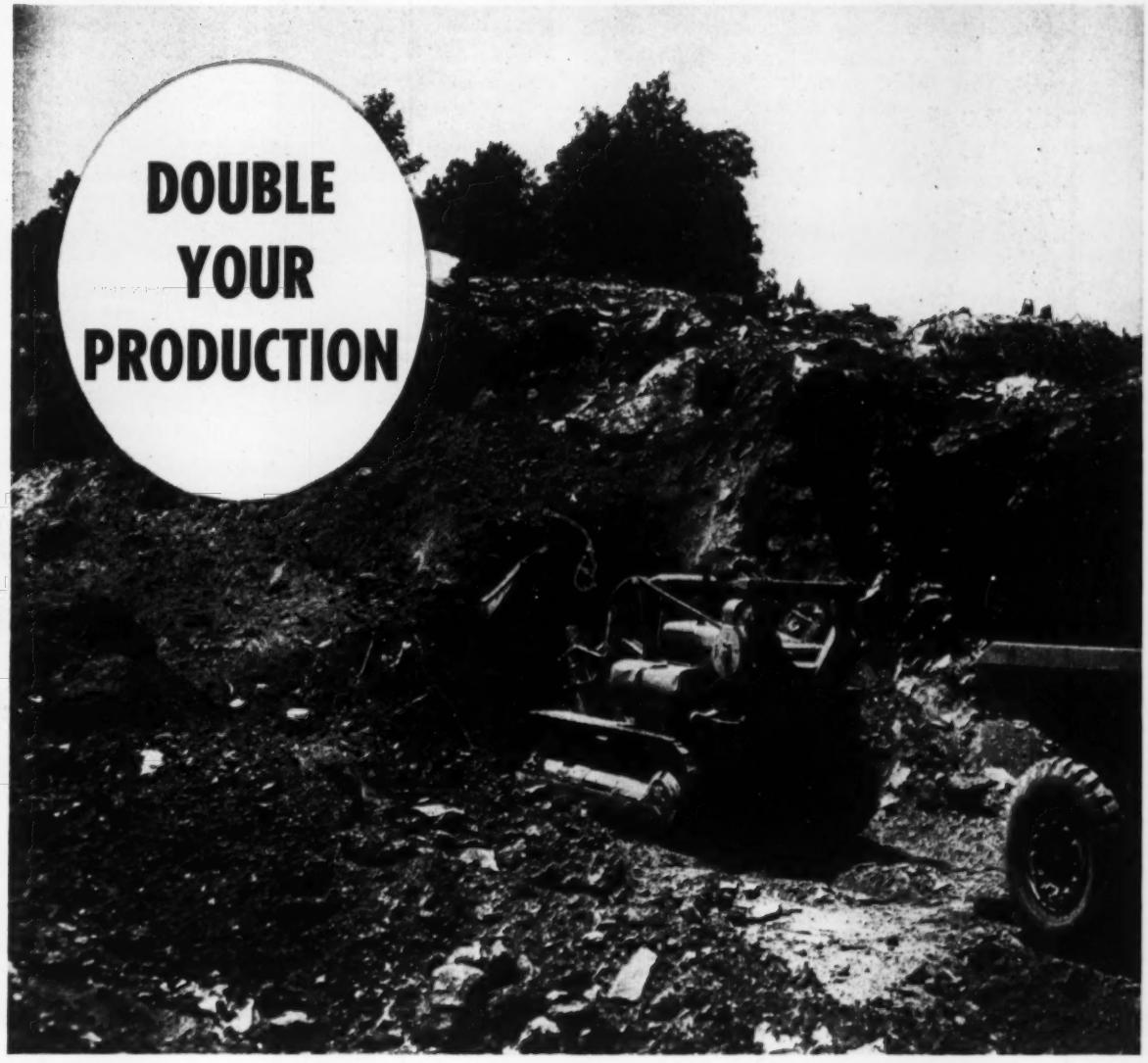
George C. Wallace, formerly division engineer in the sewer division of the Honolulu (Hawaii) Department of Public Works, has become connected with Metcalf & Eddy in Boston, Mass. **Franklin Y. K. Sunn,** a civil engineer in the sewer division, has filled Mr. Wallace's former post.

R. M. Hardy, dean of engineering at the University of Alberta, was recently appointed to the board of directors of the Foundation of Canada Engineering Corp.

John A. Crowley recently became associated with J. J. Henry Co., Inc., of New York and Philadelphia, with headquarters in the Philadelphia office at 226 South 16th Street. Mr. Crowley was formerly with the Technic Engineering Co., of Dallas, Tex.

Jean Edens, Jr., of San Antonio, announces the establishment of a consulting engineering practice, with offices at 113 General Krueger Boulevard and Blanco Road, Allena Village, Tex. Since 1947 he has been employed as a structural engineer by several San Antonio consulting firms—most recently by Matthews & Kenan.

(*Continued on page 88*)



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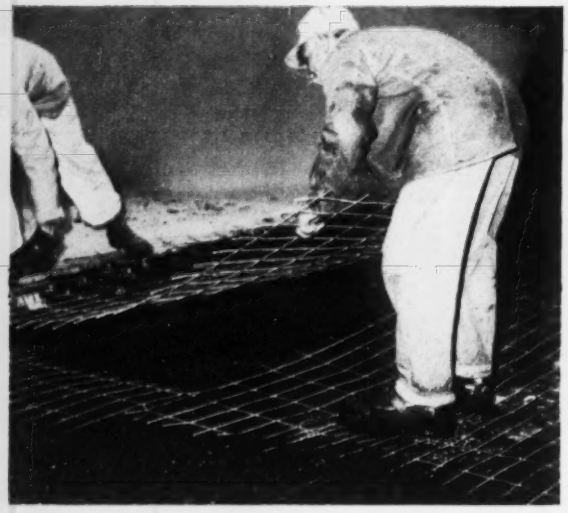
On jobs like these



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As a result, you can depend on American Welded Wire Fabric to meet your requirements, actually to give you an *extra measure* of strength and protection, no matter what job you use it on. Specify it for your portland cement and asphaltic concrete reinforcement; it's the fabric with the red and white shipping tag.

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do you know that

American is rapidly falling behind Russia in the race to produce engineers? This warning was sounded in a paper by M. H. Trytten, director of the Office of Scientific Personnel of the National Research Council, in a paper read at the fall meeting of the ASME in Milwaukee. Says Dr Trytten, the Russians have increased the number of engineering graduates from 29,000 in 1948 to more than 50,000 in 1954. In contrast, the United States graduated only 19,000 engineers in 1954. The full report will soon be available in book form.

Dutch engineers are completing repair of the dikes broken in the great storm of February 1953? An eyewitness account of the dramatic closure of the last and most difficult of the 250 tidal breaches is told in the lead article by Capt. Ira A. Hunt, Jr., the Society's 1953 Freeman Fellow, and A. Volker, engineer for the Zuiderzeeworks.

Another great dam is being finished in the Pacific Northwest? McNary Dam, one of the principal units in the control plan for development of the Columbia River, was dedicated by President Eisenhower on September 23. Five of the project's fourteen 70,000-kw generators are now in operation. The construction was handled by the Walla Walla District of the Corps of Engineers.

New ASCE officers will be installed during the Annual Convention? Nine engineers, headed by William R. Glidden as President, will take office at the Wednesday morning business meeting, October 20. Biographies and photos on page 71, and the results of the final balloting on page 74.

The steel industry is spending $775,000,000 this year to expand and modernize its facilities? According to the American Iron and Steel Institute, this expansion brings the industry's capacity to 124,000,000 tons—43 percent of the world output in 1953. Trailing the United States as prime producers in 1953 were Russia, Great Britain, Western Germany, and France—in that order.

$4,000,000,000 was spent for research in the United States last year? Contributors to this impressive research total were industry, educational institutions, and the government, according to the Arthur D. Little Research Corp.

A tiny piece of uranium can produce vast energy? A single cube of U-235—the naturally radioactive variety of uranium—the size of two lumps of sugar will produce as much energy as 1,500 tons of coal, says the Chamber of Commerce of the United States.

Thousands of engineers have been placed in good jobs by the ESPS? The effectiveness of the Engineering Societies Personnel Service may be gauged from the fact that in the 28-year period from 1925 to 1953, 114,538 engineers were registered, 103,034 positions to be filled were received, and 32,471 placements were made. ESPS listings of men and jobs available are a monthly feature.

Special studies on the proposed new Engineering Societies Building are now being completed? The report of the Special Real Estate Task Committee of UET, which has been studying sites and costs, will be ready for submission to UET at its October 28 meeting after review by the Committee on Five Presidents.

You can order preprints of any 1954 "Transactions" paper? Copies of the papers that will appear in the 1954 "Transactions" may be ordered in advance. The preprints are listed and a coupon for ordering provided on page 98. Keep in mind that members pay only half the list price.

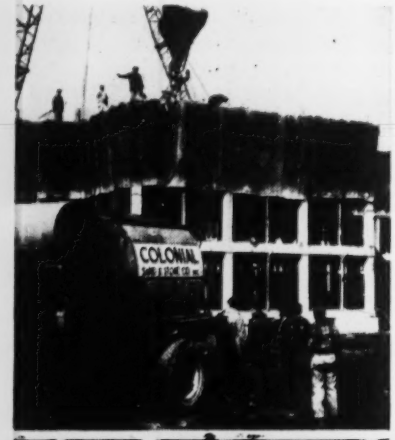
Numerous laws of interest to engineers were enacted in the closing days of the recent congress? The Society's Field Representative in Washington gives a quick rundown on legislation of special interest on page 78.

Something new is being tried to keep the New Jersey Turnpike free of fog and smoke? Devices called "weathermasters" will be placed in four fog-and-smoke areas of the turnpike, according to the Turnpike Authority chairman. The apparatus consists of a propeller driven by a motor, which will diffuse clear air blasts over the area.

Articles on the St. Lawrence Seaway and power development are being planned for an early issue?

~~CUTS~~ Winter Concreting Costs

'Incor' Saves $1 per Cu. Yd. on Heating Costs and 2 Months' Time on Hammel Houses



FRAME CONCRETING on Hammel Houses, 14 seven-story buildings, began November 16, 1953. CAYE CONSTRUCTION CO., INC. had a Winter job on their hands, and as they put it, there wasn't any question, the cement to use was 'Incor'.

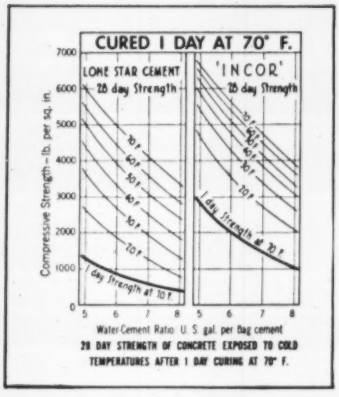
With 'Incor' 24-Hour Cement and one-day heat-protection, forms were stripped and re-used in 24-48 hours, averaging 1.3 floors a day, even at lowest outside temperatures. Heaters using propane cylinder gas provided clean, uniform heat, with minimum labor costs.

The Contractor figures 'Incor' saved two months' time and cut heating costs by two-thirds, saving $1. per cu. yd. of concrete.

Concrete design called for 550 lbs. cement per cu. yd., and 3000 psi 28-day strength. Tests showed strengths uniformly close to 4000 lbs. . . . field corroboration of data summarized in graph, shown at right, above.

The saying—"Any time is 'Incor'* time"—goes double in cold weather!

*Reg. U. S. Pat. Off.



28 DAY STRENGTH OF CONCRETE EXPOSED TO COLD TEMPERATURES AFTER 1 DAY CURING AT 70° F.

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Rockaway Beach, N. Y.
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NEW YORK CITY HOUSING AUTHORITY
Architects: **LORIMER & ROSE,** New York
Structural Engineers:
ROBERTS & SCHAEFER,
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General Contractor:
CAYE CONSTRUCTION CO., INC.,
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CIVIL ENGINEERING

OCTOBER 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

IRA A. HUNT, JR., J.M. ASCE

Captain, Corps of Engineers, U.S. Army
Freeman Traveling Scholar, 1953
Grenoble, Isère, France

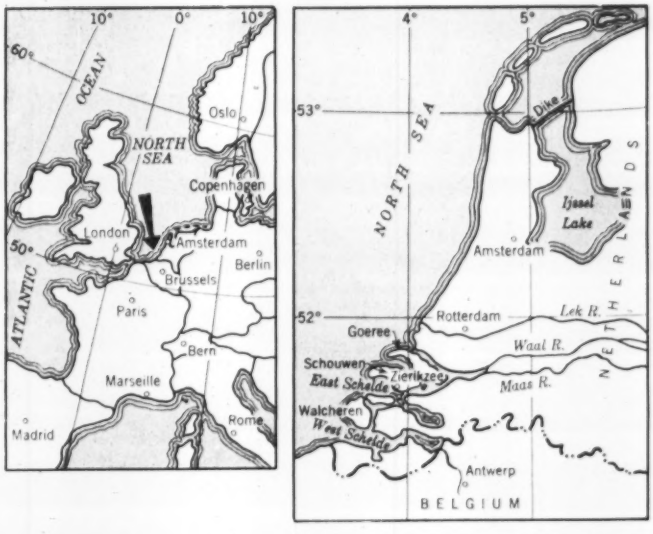
A. VOLKER

Engineer, Zuiderzeeworks
The Hague, Holland

Ten ocean-going tugs push caisson III into position at slack tide to complete closure of east gap at Ouwerkerk. Night scene was brilliantly lighted for this final operation.

Dutch close tidal breach at Ouwerkerk

Eyewitnesses describe last and most difficult closure operation



Along North Sea coast of The Netherlands, storm surge of February 1, 1953, tore 250 breaks in protecting levees. Altogether 300 miles of dikes were damaged and 400,000 acres of rich lowland flooded.

In the early morning of the first of February 1953, a great storm surge of the North Sea struck the coast of The Netherlands causing over 250 breaks in the dikes. Of the 700 miles of sea dikes in the southwest part of the country, over 45 percent were damaged. At some places the whole dike vanished for a distance of several miles, at others only heaps of earth remained, and at still others the land slope of the dike was eroded to such an extent that it seemed any additional scouring would cause complete collapse. As a result of the breaching of these dikes, approximately 1,800 persons lost their lives, 100,000 were made homeless, and more than 400,000 acres were inundated.

Where there were no tidal currents, the breaches could easily be repaired. However, there were 67 breaches through which the tide ran in and out. The tidal currents varied with the height of fall of the tide and the size of the inundated polders, ranging in velocity from 3 to 16 fps (feet per second).

Worst breach, at Ouwerkerk, on south side of island of Schouwen, was finally closed November 6, 1953, in epoch-making operation described in this article. To avoid similar disasters in future, all Holland's dikes will have to be raised or, as recently recommended by special Delta Commission in report to Dutch Government, four estuaries between islands will have to be closed off at points indicated by heavy dashed lines. This operation would require massive sea wall estimated to take up to 25 years to build and costing four or five hundred million dollars.

The breach in the dike at Ouwerkerk, a small town not far from Zierikzee on the south side of the island of Schouwen, proved the most difficult to close and one of the most expensive. There were two breaches in the dike there, both scoured to a depth of about 50 ft.

General principles of dike closure

The problem of closing tidal breaches in dikes is not new. In the past certain principles have been generally followed:

1. The work of closure should commence as soon as possible so that the breach will not be given an opportunity to enlarge.
2. If the bottom is easily eroded, it should be prepared with a series of mattresses.
3. The closure should be made in such a way as to avoid the deep gullies and strong currents in the breach. Usually a semicircular dam is built around the breach.
4. If the breach is very wide, it should be narrowed as much as possible without materially increasing the tidal currents.
5. The final gap should be closed by dumping stone or clay along a wide front, thus building up a weir. This weir will effectively reduce tidal variations in the inundated area, the current, and of course the amount of water flowing in and out. As the bottom is built up, the work becomes much easier.

In the case of the breach at Ouwerkerk, time was of the essence, for it was necessary to complete the closure before winter, when new storms would cause more damage. Because of the time factor, the lack of stone in sufficient quantity, and the need for economy, it was decided to close the gaps by the more modern and daring method of utilizing small prefabricated concrete caissons (36 × 25 × 20 ft) which could be assembled into larger elements. These elements would be floated into place and sunk.

The first step in closing the breaches was to build a ring dike out into the bay, leaving two gaps where the water could enter and leave the flooded area at high and low tide (Fig. 1). The water was very shallow here because in former days it had been a polder. The western gap, "AB," was 16 ft deep and 260 ft wide. The eastern gap, "CD," was 330 ft wide, and it was necessary to dredge it to a depth of 26 ft so that the currents in the gap would not become excessive. The changing tidal conditions gave the engineers much trouble with this dredging, and it was necessary to bring in one of the largest dredges used on the Ijssel Lake reclamation. In all there were 12,900 sq ft of gap where the water entered and left the polder with the changing tides.

First attempt fails

Once the proper dimensions of the gaps were obtained, the bottoms were prepared with willow mattresses and stones. It was then planned to complete the work on the 24th and 25th of August 1953, by first closing the western gap, and immediately thereafter the eastern gap. However the tide was a little stronger than expected because of an unforeseen one-day delay, and there was a slight wind setup. The velocities through the gaps were excessive and the sand beneath the mattresses began to erode. The two sets of reinforced concrete caissons first placed in the western gap did not meet and another set of five caissons had to be rushed in. These capsized, and a final set of five had to

In first attempt to close Ouwerkerk breaches, August 25, 1953, small concrete abutment caissons in eastern gap collapsed as result of scour.

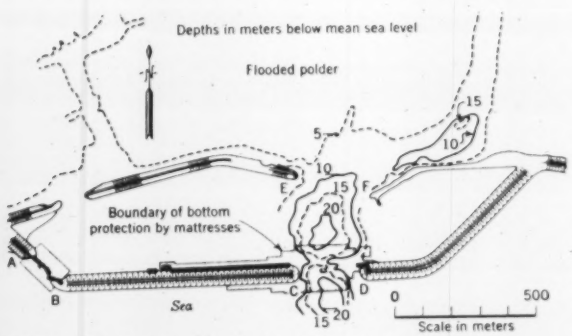


FIG. 1. Original plan for closing tidal breach at Ouwerkerk involved use of small concrete caissons to close two gaps in ring dike which had been built out into bay. In first attempt, western gap was closed with caissons as here shown, under difficult conditions of wind and tide, but no time remained to close eastern gap, through which high tide raged, scouring bottom to depth of 82 ft. Maximum tidal flow through these breaches equaled one-fourth of average flow of Mississippi.

be placed to effectively close the western gap. In doing this, all the equipment planned for use at both gaps had to be employed.

No time and no equipment remained for work on the eastern gap before the high tide swept in. The 8,600-sq ft opening there could not handle the tidal flow. Erosion was steady and disastrous. The abutment caissons collapsed and the water scoured to depths of 82 ft.

Now a completely new closure attempt had to be made at the eastern gap. First, it was decided to construct dikes between the old and new dikes so that there would be only one gap to contend with (Fig. 2). From the previous failure two important lessons had been learned: first, that velocities of over 16 fps were very dangerous and it was doubtful whether the mattresses would stand up under such currents; second, that more time is available for the placing of caissons in a breach if the work commences with the ebb slack water rather than with the flood slack water.

Taking into account the surface basin, the tidal movement, and the depth of the water, the size of gap necessary to maintain velocities less than 16 fps was computed. However, this time, in order to be safe, allowance was made for a wind setup of 4.9 ft superimposed on the normal tidal range of 4.6 ft. By this means it was determined that a gap of 26,000 sq ft must be prepared. The depth was to be 46 ft and the width approximately 560 ft.

In order to close a gap of this width in a reasonably short time, it would be necessary to use large Phoenix caissons (204 × 62.5 × 59 ft). Such caissons had been used previously but never to close so large a gap. Some experience had been gained in maneuvering these large reinforced concrete caissons with the closing of the gaps at Kruiningen and Schelphoek. But many unknown factors had to be determined. Thus it was that the Waterloopundig Laboratory at Delft played a vital role in this great work. Every day soundings and profile measurements were taken at the job site and the changes that occurred were followed in the laboratory. Tidal variations were predicted both inside and outside the polder. A number of methods of placing the caissons were tried. The engineers in the field worked hand in hand with the engineers in the laboratory. Finally the plans for the closure were drawn up in the laboratory (Fig. 3).

A series of charts were drawn up showing the exact method of placing the caissons and giving the cable tensions and compressive forces necessary to accomplish the work. Other curves were drawn to show the tidal variations and velocities to be expected as the closure progressed. The most critical time would be after caissons I, II and IV were placed, and the gap had been reduced to 2,300 sq ft (Fig. 3). According to the prediction, the velocity would then be 14.8 fps, a tremendous flow. If any wind setup were to occur at this time, velocities would be excessive and the whole project in danger of failure.

For two months the laborious work of preparing the bottom went on. Skilled teams of laborers wove huge willow mattresses at a site near the gap. These were floated into place at high tide, and barges loaded with rock brought from Germany and Belgium unloaded their cargo on the mattresses to sink them. Nearly 50 acres, or 240,000 sq yd, of mattress area was used to build up the bottom.

Many dredges and pipelines were used in the work of extending the old dike and building the new cross dikes. Finally small caissons were sunk at the ends of the dikes in the line EF (Figs. 1 and 3).

On October 30, 1953, the huge Phoenix caisson I was placed. Quickly smaller caissons were sunk, and the area between the two rows of caissons was filled with sand and clay. Thus the west side of the gap was prepared, with little or no leakage, for the sinking of caisson IV. Then on Thursday morning, November 5, this caisson was sunk.

Of special interest is the method of closing the small gap between the smaller abutment caissons and the Phoenix caisson. For this, an arrangement called a guillotine was used—a steel construction with iron piling attached to the large caisson. These piles were dropped to effectively close the slanting gap (Fig. 4). This type of guillotine construction has been used effectively in many places.

Although the first two caissons had been successfully placed, the critical test was to come. As the weather was good and the tides very low, only 24 hours were to elapse between the sinking of caissons IV and II, and only twelve hours between the sinking of II and III. Thus it was decided to sink II on Friday morning, November 6, and the last one, III in the evening of the same day.

Caisson II, the third caisson to be placed, was swung into place with the help of seven ocean tugboats and cables attached to caisson I. The time allowed for this maneuver was about

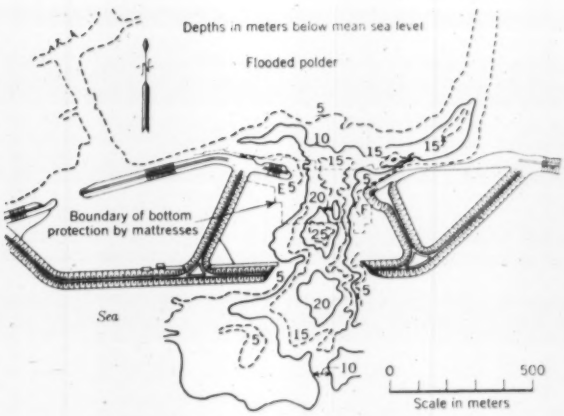
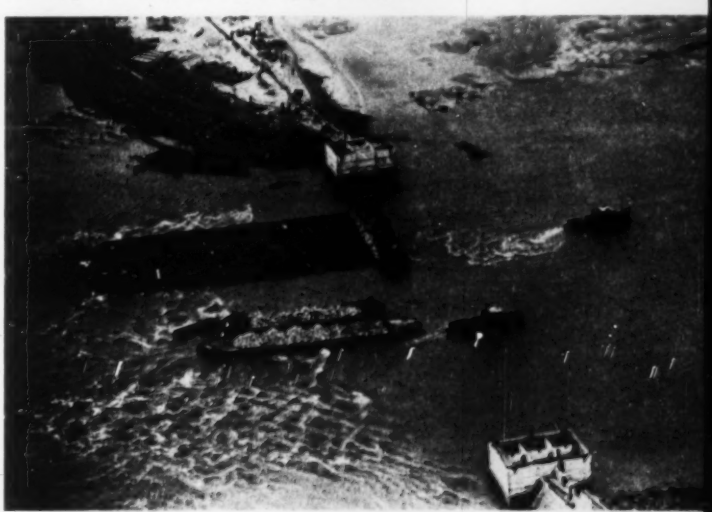


FIG. 2. Plan of eastern gap after failure of first closure attempt shows extension of old dike, new wing dikes, and mattress protection prepared for second (and successful) closure attempt.

Nearly 50 acres of willow mats, sunk with stones up to 6 cu ft in size, were used to protect bottom of eastern gap from scour.



1½ hours, and the caisson was sunk by opening the ballast gates in its bottom. The sinking operation took 30 minutes. Soon after the sinking of this caisson, a landslide 110 ft long occurred on the inside of the levee. Barges of stone were emptied, cables secured, and 500 cu yd of sand and water were pumped into the caisson for ballast.

While caisson II was being placed, caisson III was being brought forward and moved in behind caisson I in readiness for placement to close the final breach. A large bucket dredge had securely fastened its buckets into the bottom and the caisson was moored to it and to caisson I.

Final closure effort

At 2:00 in the afternoon, when high tide came, the gap was only 2,300 sq ft in area, and the water raged through the opening. Velocities were measured at 13 fps. Huge vortex trails formed well into the polder. Near the two caissons, the water "boiled." The difference in elevation at the face of the two center caissons and just around the corner was 4 ft. The contraction of the flowing water appeared to be a maximum of 0.6. The dynamic force of the water was almost unbelievable as it rushed in at 18,000 cfs. An old barge which had been beached near the town of Ouwerkerk, one mile inland, was torn loose and floated away. The question in everyone's mind was whether the bottom was being eroded or not. Stones could be heard striking against the steel part of the caissons.

The bottom had been prepared with stones weighing from 600 to 900 lb apiece. As slack tide approached, soundings were taken, proving that holes 3 ft deep had been gouged out of the bottom, but that the general profile remained correct. Near the two center caissons 3 ft of rock had been washed away.

At 7:30 in the evening the ebb tide began to gain strength. Although its velocities would not exceed those of the flood tide, it was dangerous because it posed a threat to the last caisson, III, which it was hoped, was firmly attached to caisson I and to the dredge. The main gully swerved to the right just past the gap and the water entered the gap at a sharp angle.

Although five tugboats were pushing caisson III inland, the tugboat captains became alarmed at the swirling water around them and issued a call for help. Frantically more boats rushed to the scene until ten in all were pushing at full steam against the caisson to keep it from being swept out into the current. Laboratory tests had proved that the currents would not be dangerous, but the seaman's instinctive fear of swirling foam created a tense moment.

The darkness was dispelled by three 100-ft towers each giving 19,000 candle power of sodium light. Each caisson had ten sodium lights attached, and in addition four huge searchlights were focused on the area.

The actual placing of the last caisson began at 9:45 p.m. It was slowly moved up behind caisson II by some ten ocean tugs. Steel cables were secured to caisson II, and caisson III was swung easily into place and sunk. At 11:57 p.m. Ouwerkerk dike was closed. The Dutch engineers had been blessed with low tides and perfect weather. So thorough had been the planning that the placing of the last caisson looked just too simple!

The scene Friday night had been awe inspiring, with the sodium lights and searchlights lighting up the array of boats and barges assembled for the closure. It looked like the busiest port in the world. There must have been a thousand boats in the harbor during the day.

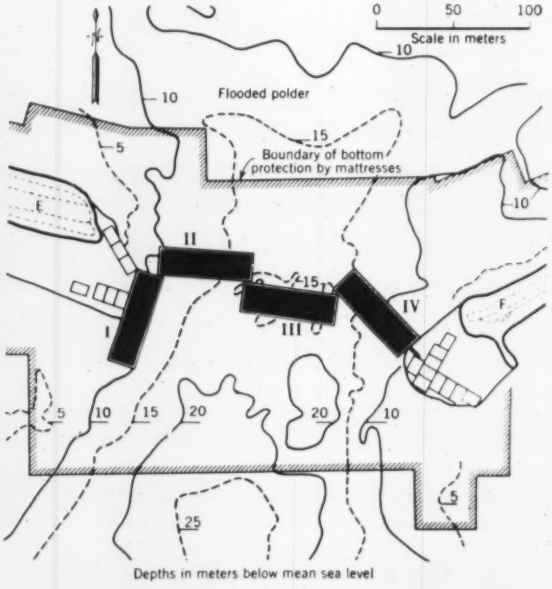
Rejoicing throughout Holland

The Queen attended the final closure and made an early morning radio speech. The closing of Ouwerkerk completed the reclamation of 400,000 acres of inundated land. The next day the national flag was displayed throughout Holland.

Certainly this was a great moment in the history of the closing of tidal breaches. The method used was new. The accomplishment was difficult. But for the Dutch it was only the initial test, for the Netherlanders are confronted with a tremendous task. Now that the damage of February 1, 1953, has been repaired, they must set about preventing the recurrence of such a

First caisson placed in second, and successful, closure attempt at eastern gap was I, followed by IV.

FIG. 3. Closure plan for eastern gap, prepared after extensive model tests at Delft Hydraulic Laboratory, involved placing of four huge reinforced concrete caissons. Final closure took place on November 6, when caisson II was placed in morning, followed by III in evening.



General view of working area on day of final closure, November 6, 1953, shows ring dike which had been built out into bay, at left, around original break.

disaster. Two courses of action are open to them, either to raise approximately 700 miles of dikes or to build huge sea dikes closing off the arms of the sea and making fresh-water lakes out of the present estuaries.

The Dutch Government has appointed a committee of experts, the Delta Committee, to study the two courses of action. If the committee decides that the closing of the estuaries is feasible, Dutch engineers will be faced with closing the sea arm of the East Scheldt with its tidal flood capacity of 700,000 acre-ft at an average tidal range of 9 ft. The proposed dam will have to cross three tidal channels. The experience gained in closing the breach at Ouwerkerk will be invaluable in such an operation.

The organization in charge of the closure of the dikes at Schouwen-Duiveland (Ouwerkerk, Schelphoek) was the Service of the Zuiderzeeworks, under the supervision of the Rijkswaterstaat, which was in charge of closure of dikes in the entire inundated area. The engineers responsible for the execution of the work here described were F. J. B. G. Geers and C. J. van den Bout, chief engineers of the Zuiderzeeworks, and C. A. de Vlieger, engineer of the Rijkswaterstaat. The principal contractor was Zuiderzeecombinatie Zanen-Verstoep and van der Hoeven, Lim. Comp, one of the contractors of the Zuiderzeeworks.

The closing and repair of all the dikes cost some 500 million Dutch guilders ($1.00 = 3.80 guilders). The closing of the breach at Ouwerkerk cost 26 million guilders ($6,850,000).

All photographs are by Royal Dutch Air Lines.

In preparation for final closure with caisson III, this caisson was drawn up in starting position behind caisson I and securely anchored to it and to large dredge, held by its own buckets fastened into bottom.

→

Four huge caissons filled with sand and water are seen in place after monumental closure operation at most serious breach made in Holland's dikes by storm of February 1, 1953.

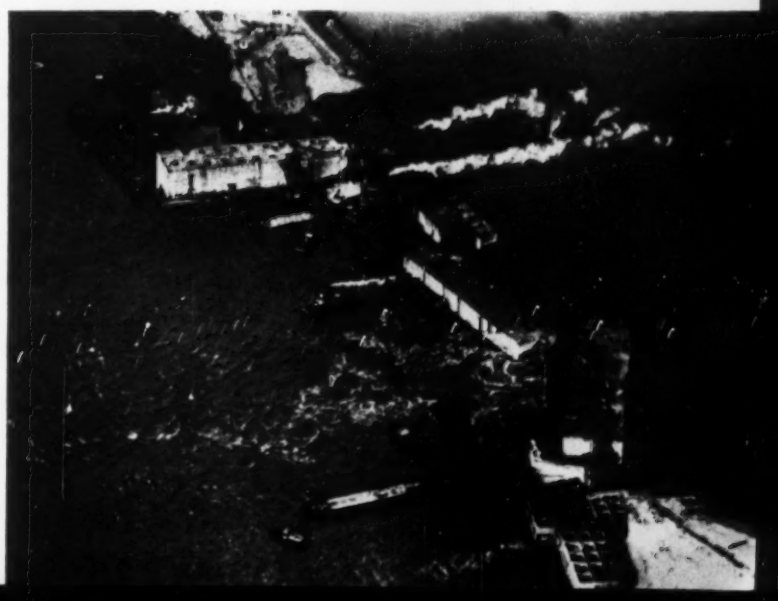
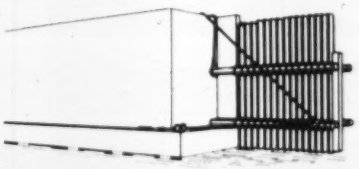


FIG. 4. "Guillotine" attached to caisson is arrangement of iron piles which is lowered, after sinking of caisson, to close sloping gap between caisson and abutment.



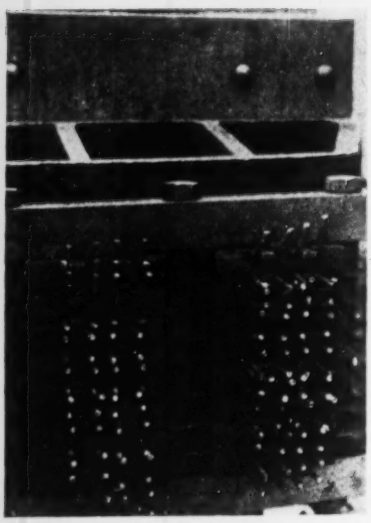
Each 30-ton half-truss, after being assembled on ground under its final position (view above), was lifted into place between legs of two 35-ton steel A-frames 82 ft high (middle view). When seated on supporting columns (view at far right), half trusses were bolted to central panel fixed to top of interior column

GUSTAV P. MAGNEL, M. ASCE

Professor, University of Ghent, Belgium

Long prestressed-steel truss erected for

First practical application indicates



Wires of prestressing cables are anchored in sandwich plates of type generally used for prestressed concrete in Belgium (Magnel system).

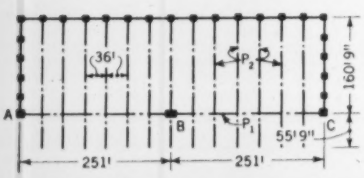


FIG. 1. Melsbrock Airport hangar covers area of $2^1/_2$ acres with one interior column.

The recently completed structural steel hangar at the Melsbrock Airport, Brussels, provides a clear height of 40 ft and covers an area of 502 × 215 ft with but one interior column. This single interior column is located 56 ft inside the main front doors and at the midpoint of the length of the hangar (Fig. 1).

The key to this design is a continuous main truss of structural steel, $\mathbf{P}_1$ in Fig. 1, built with two spans of 251 ft each supported by the central column **B** and the end-wall columns **A** and **C**. Thirteen secondary roof trusses, on 33-ft centers, span the 159 ft from the back-wall columns to the main truss and cantilever forward 56 ft further to the main doors of the hangar. These secondary roof trusses carry steel purlins on which precast lightweight concrete panels were placed and covered with a waterproof membrane. The usual bracing and stiffeners complete the structural frame.

Main truss prestressed

The main truss is prestressed, as shown in Fig. 2. Its depth at midspan is 13 ft 9 in. (about 1:18 of the span) and the depth at the central column is 18 ft 4 in.

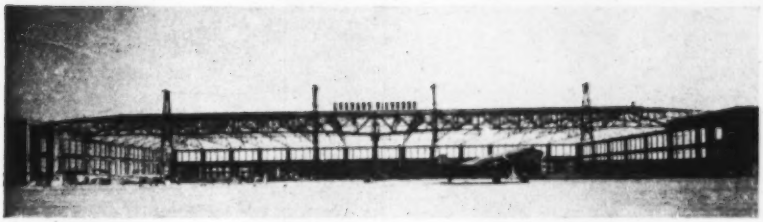
The top and bottom chords of this double truss are each built up of four channels 4 × 12 × $^3/_8$ in. as shown in Fig. 3. The truss was assembled on the ground in two riveted halves. After erection these halves were joined by bolting them to a steel panel fixed on top of the central column **B**.

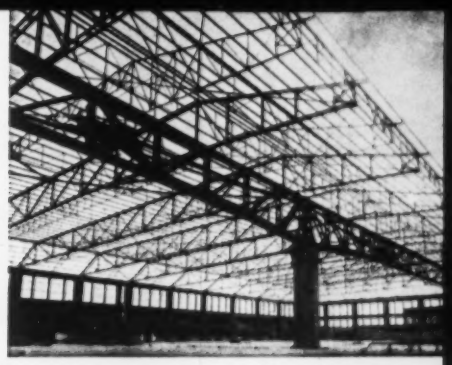
The truss is prestressed by means of four cables, each of 64 wires of 0.276-in. diameter. The position of these cables is indicated in Fig. 2. Two of them start at the left-hand end, follow the lower member over a length of 75 ft, then curve upward across the central column and slope downward again to terminate at the third point in the adjacent span, 84 ft from the central column. The two other cables are placed symmetrically as compared to the first two. Thus two cables are provided at the bottom chord at the mid span of each half-truss, and four cables pass over the central panel.

The truss is fixed at the central column, and the two end supports allow for free expansion. Half the truss weighs 61 tons. Each half was hoisted into place between the legs of two 35-ton structural steel A-frames, 82 ft high.

First, the central panel of the truss was placed on top of the central column. Then, one after the other, each half-truss was erected, after which the two halves were bolted to the central panel, thus making them continuous. The hoisting of one half of the truss required but 20 minutes.

The prestressing was done after all the steel skeleton was in place (385 metric





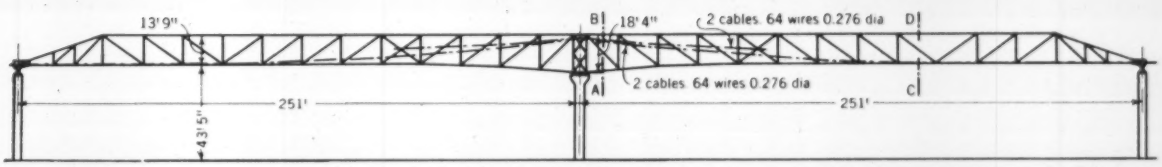


FIG. 2. Continuous prestressed-steel truss, 502 ft long, is supported by single interior column and two wall columns.

Belgian hangar

economy of prestressed steel

tons). The cables used are the same as those generally used in Belgium for prestressing concrete. A photograph shows one of the anchorages taking two cables of 64 wires each.

The prestressing force for two cables (128 wires) is initially equal to 360 tons, or 105,000 psi. A loss of prestress in the course of time of 9 percent has been taken into account in the design. Under full downward load, the stress in the wires after complete loss of prestress in the mild steel reaches again 105,000 psi. Under full upward action of the wind, and after complete loss of prestress, the stress in the wires drops to 93,000 psi. This means that, after complete relaxation, the stresses in the wires vary from 105,000 to 93,000 psi, a variation of 13 percent from the minimum stress. The stress in the mild steel of the main truss never exceeds 21,000 psi.

Design loads and deflections

Apart from the dead load, the roof was designed to carry a snow load of $7^1/_4$ lb per sq ft and the following wind loads: $12^1/_2$ lb per sq ft on vertical surfaces; a downward load of $6^1/_4$ lb per sq ft on any surface; and upward pressure, with hangar doors open, of $12^1/_2$ lb per sq ft; and uplift from the outside of $6^1/_4$ lb per sq ft. Consequently the roof is designed to resist a total upward pressure of $18^3/_4$ lb per sq ft.

The snow load gives a maximum deflection at mid span of $2^1/_2$ in. The wind in the upward direction gives a total upward deflection of 4 in. Consequently the maximum variation in position of the lower chord at mid span is $6^1/_2$ in.

Economy increases with span

The economy in weight as compared to a conventional steel design is 12 percent, and the economy in cost is 4 percent. However, had the wires been prestressed up to 130,000 psi (which is quite acceptable) instead of the 105,000 psi actually used, the economy in cost would have been about 6 percent. The above figures are based on the actual cost and not on the prices given in the contractors' bids.

It is to be noted that the longer the span the greater the economy. For a span of 300 ft, the economy in weight is about 25 percent, and the economy in cost, 18 percent.

The methods of design and calculation are simply based on the conventional elastic theory. Those interested in this aspect of the problem can refer to a paper by the writer in the Belgian periodical *L'Ossature Métallique*, No. 10, October 1953.

The steel structure was manufactured and erected by the firm of S. A. L. Leemans & Fils, Ateliers de Construction à Machelen.

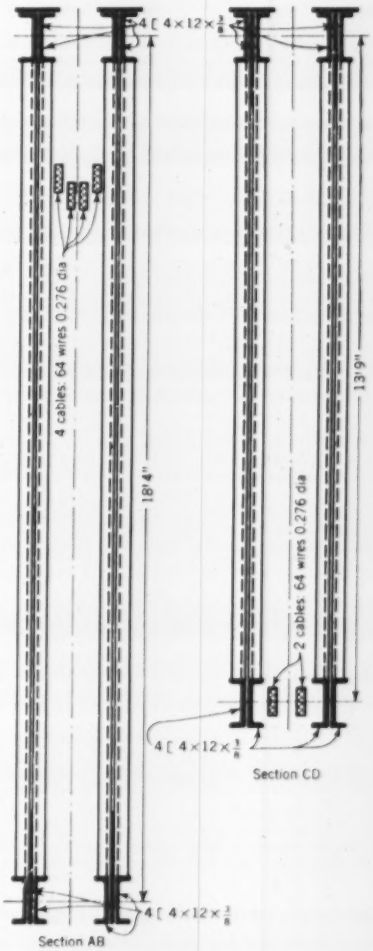


FIG. 3. Both chords of double truss are built up of four 4 × 12 × $^3/_8$-in. channels.

I. Coral for aggregate

Good concrete made with coral and sea water

D. LEE NARVER, M. ASCE, Holmes & Narver, Inc., Engineers-Constructors, Los Angeles, Calif.

Concrete construction on coral atolls in the absence of conventional aggregates and with severe restrictions on the fresh water supply, is not a new problem to military engineers. Answers to this problem in the past decade, during and after World War II, have made coral concrete fairly common and have demonstrated its importance in Pacific Ocean areas. In addition to purely military considerations, the efficiency of maximum use of local materials, and coral concrete's resistance to accelerated deterioration and cyclonic storms, will continue to invite engineering attention.

Yet, until now, authoritative criteria have been limited. The long series of controlled tests and observations which can now be reported not only projects the technique of coral and sea-water concrete design into the realm of predictable results, but appears to make obsolete certain heretofore accepted data in the available bibliography. For example, sea-water concrete with coral aggregate is actually up to 17 percent stronger during the first month than the identical mix made with fresh water, because of an accelerated development of strength attributed to the sea water. At the end of a 90-day period, the sea-water concrete has reached a strength which is only 6 percent lower than that developed by the fresh-water concrete in the same length of time. With the coral aggregate employed and the uniformly mild temperature experienced, the accelerated strength resulting from the use of sea water may prove desirable in many cases.

The new data derives from extensive construction programs on two coral atolls of the central Pacific Ocean. In both locations, sources for fine and coarse aggregates were unknown. The programs on which this report is based required stockpiles in several areas and each stockpile required thousands of cubic yards of aggregate to economically produce a 3,500-psi concrete. The scope of the new data, as now reported by the project's design engineers, therefore encompasses pioneer research into quarry selection and characteristics, as well as extensive field and laboratory tests. It should be noted that the larger Pacific islands, which lack the atoll pattern and rise to considerable height, may yield coral aggregates in hill quarries under soil overburden. Little correlation was found between this and the reef-coral techniques to be discussed below.

The nature of coral

Geographic distribution of coral extends throughout the world, although reef-building corals are most common in tropical zones, and in waters constantly above 65 deg F. The present discussion refers to central and west Pacific waters only. The coral polyp colonies which produce the characteristic limestone masses are observed to take many shapes, such as irregular crusts, dome-shaped masses, or tree-like branching structures. They produce skeletal colony forms of varying specific gravity and shatter characteristics. Apparently their combined accretion of successive infinitesimal deposits of calcium carbonate, together with shattering and hydraulic and chemical consolidation, builds up the foundations for three observable structures: (1) fringing reefs, the submerged platforms of living coral extending out from a shore; (2) barrier reefs, which follow a shoreline but are separated from it by a waterway; and (3) the atoll, which is a necklace of islands enclosing a lagoon, connected with the open sea by one or more channels. The observations here recorded have specific reference to coral as found on an atoll, the Marshall Islands being typical of such atolls.

Exploratory drilling in the area of the Marshalls, as reported in a Bulletin of the American Association of Petroleum Geologists (Vol. 37, No. 10, October 1953), indicates that although the atoll rests on igneous basement rock, the submerged reef structure originated as coral and is more than 4,000 ft deep. The small, low-lying islands which emerge, are connected more or less irregularly by a coral shelf which is awash at most tides. The dry land of the small islands seems to be formed by wind and wave action, breaking up the weaker and smaller parts of the coral and then depositing them on top of the reef, usually closer to the lagoon side than the ocean side. The general character of the dry land is that it contains finger coral, loose sand, and some humus. It seldom rises to a height of more than 20 ft above high tide, and mostly not more than 10 ft.

An attempt to quarry favorable pockets of this material and to use it in concrete showed that the material was poorly graded, too soft and porous, and produced concrete of low strength. Drill holes showed that underneath the loose surface layers there was usually a crust of harder material, the top of which was about at high-tide level. This material extended downward in layers varying in thickness from 6 in. to 15 ft, separated by lightly cemented coral sand. Beneath this crust the material became much more pulpy and in places too soft to core. However, there were also lenses of quite hard material in the lower strata.

There are varying theories as to the formation of this hard crust about at water level, one being that the reef was formed uniformly below the surface of the water and that later loose mate-

At Eniwetok and Bikini, the Atomic Energy Commission's Pacific Proving Ground, coral aggregates and sea water have been used for the past seven years for heavily reinforced concrete structures. Atolls, composed entirely of coral, are without the fresh water and rock aggregates normally used for concrete. Controlled research and field tests by the author's firm ultimately produced concrete made with sea water and coral of a strength sufficient to meet the severest building requirements. The article which follows presents results of pioneer tests on coral aggregate, tells where and how to find aggregate of the best quality, and how to test, quarry, and stockpile it. A second article by Mr. Narver, in the November issue, will tell how to design and control coral-aggregate mixes, and relate several beneficial effects of using sea water for mixing coral concrete. This field experience indicates that some of our previous concepts about concrete are no longer valid.

rials were piled up on top of the coral. This does not, however, account for the pulpy material found by drilling. Another theory is that the reef was built up in two parallel ridges and that the valley between was filled with breakage from the outer reef and then the successive rains washed cementing material from the coral sands and deposited it at the ground-water level, gradually building up a cemented crust at that level.

Fringe reefs on the ocean side of atolls have a hard crust that in general is observed to have the following pattern:

1. The top layer is a porous coral of low specific gravity with a high absorption percentage. This most recently formed layer will average 24 in. in depth and may be used for fills, compaction, and roads. It has little value for structural concrete.

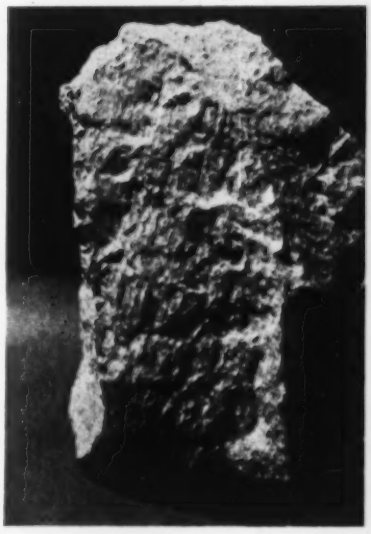
2. The second layer is usually a cemented conglomerate of the first and third layer. It is excellent for riprap, dikes, causeways, etc. It should preferably not be used for structural concrete.

3. The third layer is a solid and homogeneous indurated coral desirable for concrete aggregate. This layer varies in thickness from a few inches to over 16 ft. For drill and blast purposes, and in order to work economically, a thickness of at least 4 ft is desirable.

On the lagoon side of the atolls, the coral reef extends shelf-like for varying distances up to a half mile and then drops off rather abruptly to the deeper part of the lagoon. This coral shelf at the water's edge appears to have a hard crust, but usually is not of sufficiently high specific gravity to make good concrete aggregate. Wood piles can be driven through it. Its absorption percentage is usually high, in the order

TABLE I. Results of coral aggregate prospecting (Fig. 1)

Site	Specific Gravity	Absorption, %	Character
Island No. 1:			
Location A	2.63	1.17	Excellent at 6 ft
Island No. 2:			
Location B	2.62	1.88	Excellent and good quantity
Island No. 4:			
Location D, top layer	1.74	38.6	Finger coral
Location D, middle layer	2.05	10.20	Cemented conglomerate
Location D, bottom layer	2.65	1.00	Exceptional; good supply
Island No. 7:			
Location E	2.53	3.64	
Island No. 11:			
Location F	2.33	6.66	Quantity restricted but probably better than average rock
Island No. 12:			
Location G	2.62	2.18	Quantity adequate



Good coral aggregate comes from location such as island No. 1 in Fig. 1 has specific gravity of 2.63 and absorption of 1.17 percent (Table I). It is rose colored when quarried, fading to shell pink on exposure.

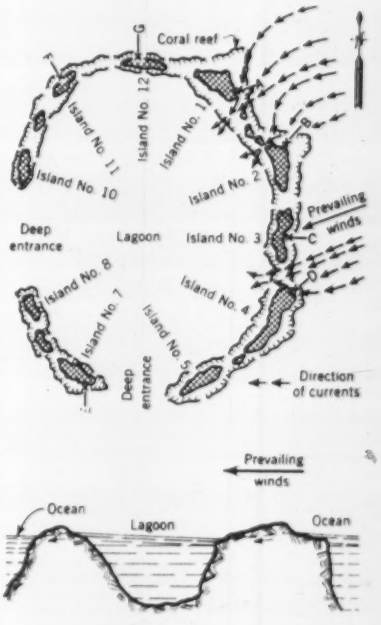


FIG. 1. Sketches of a typical Marshall Islands atoll (representative not actual) illustrate direction of prevailing trade winds and hydraulic gradient resulting from their effect on water surfaces.

Samples are characteristic of three types of coral usually found in hard crust at about water level. Top sample is finger coral found in top layer; it is relatively new in age and has high percentage of absorption (40 percent). Middle sample, from middle layer, is cemented conglomerate, likewise having high percentage of absorption (10 percent). Bottom sample, from lower lense, makes excellent aggregate. It is hard, dense, translucent bone-white, with smooth, oleagincus appearing surface (Table I).

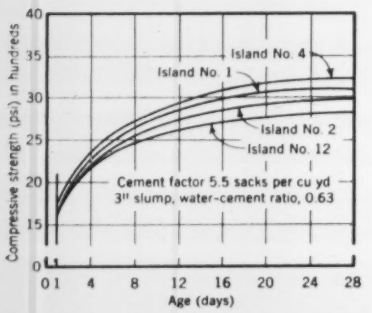


FIG 2. Test results give compressive strengths of coral aggregate concrete in relation to specific gravity and absorption.

of 12 percent. This coral structure can usually be broken up with a rooter and crushed with heavy rollers. This makes good material for base courses for runways and roads.

Harder on ocean side

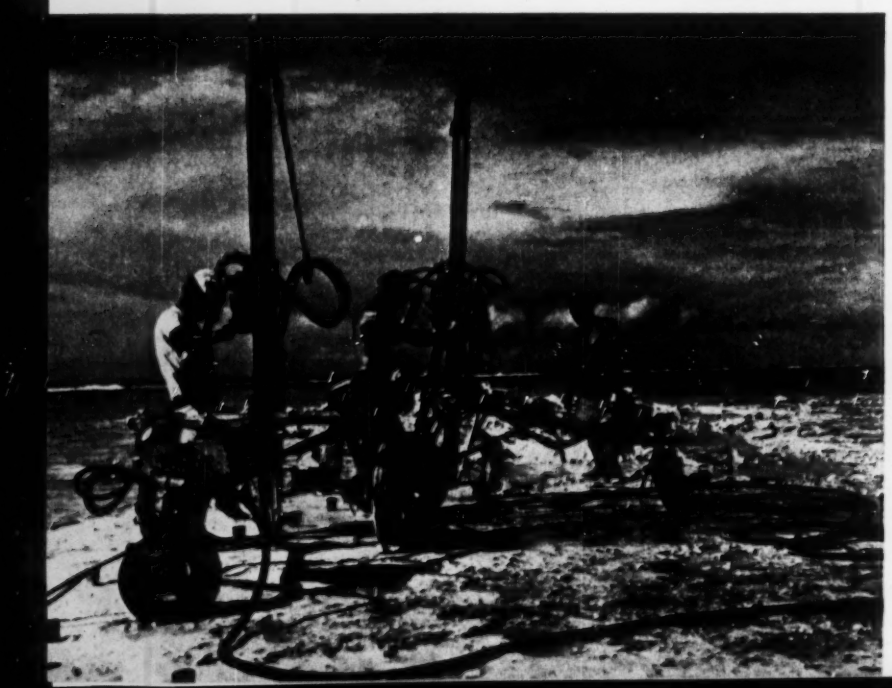
Coral on the ocean side of the islands, in contrast to that on the lagoon side, has to be quarried by drilling and shooting. Why the coral on the ocean exposure is harder than that on the lagoon exposure has not been definitely determined. A difference in the two conditions is that the surf is constantly breaking on the coral on the ocean exposure, while on the lagoon side there is little more movement than the rise and fall of the tide. One theory is that the coral is hardened by the constant aeration of the water on the ocean side of the reef, while on the lagoon side the only aeration the reef gets is between tides. Another theory has to do with the food supply for coral growth. The density of skeletal secretion by reef-forming coral polyps, according to this theory, is affected by the degree of concentration of plankton, nutrient salts, and oxygen available to the living organism. On the windward islands the reefs on the ocean side receive the greater concentrations of such nutrients.

In the Central Pacific atolls, such as the Marshall and Gilbert Islands, the Trade Winds blow from a constant direction slightly north of east. This builds up the water level on the ocean side of the windward islands, creating a hydraulic gradient, as shown in Fig. 1. Therefore, regardless of tides, the ocean water is constantly flowing into the lagoon on the windward side and the lagoon water on the leeward side flows into the ocean. It will be noted that the flow of the ocean currents parallels the Trade Winds, and as these currents pass over the coral reefs into the lagoon, a funneling condition is created. Thus on the ocean side of the windward reefs there is a concentrated food supply for the polyp. These windward reefs are adjusted to the constant heavy surf and are able to withstand storm damage. The leeward reefs are adjusted to the normally small waves in the lagoon and are not able to withstand storm damage.

The hydrographic chart for the Marshall Islands shows that there are 33 atolls. Of these, 25 are similar in pattern in that the larger islands are on the eastern or windward side with a few small islands or reefs on the leeward side. There is always a central lagoon with deep-water channels into the lagoon that are usually from the south or the west, or from both sides. The typical atoll, shown in Fig. 1, is likewise applicable to most of the Gilbert Islands as well as to several in the Caroline group. The extension of the ocean windward reefs, as shown for Islands 1, 2 and 4, is likewise typical.

Coral aggregate prospecting

Past experience and records of previous work on similar atolls showed coral deposits in various forms and with wide variations in character, specific gravity, and percentage of absorption. Thousands of test results were reviewed



to determine if any criteria for the selection of the coral could be established.

This review did indicate that lagoon sand and lagoon reef rock should not be used when ocean reef material was available. The manner in which hard coral occurs in an ocean reef is most haphazard, and thus requires a considerable amount of exploratory work. Quantity as well as quality at a given location must be determined in order to economically justify the setting up of stockpiles. With this problem, as with all engineering problems, time is of the essence. To explore the entire circumference of an atoll by drilling test holes would be prohibitive in cost and time would not permit it. To expedite the exploration work, it was decided to concentrate on certain areas based on the following assumptions, predicated on the theory of concentration of food supply:

1. That the better corals would be found on the windward side of the eastern islands.
2. That the best corals would be found in areas where the shoreline is perpendicular to the prevailing winds and where the current is strongest.

The four principal methods of obtaining coral aggregate are by dredging, dragline, shovel, and drilling and blasting. Dredging is usually undertaken to provide a channel or anchorage for vessels inside the lagoon. The dredged coral is usually not suitable for first-grade concrete. Dragline and shovel operations produce a fair coarse aggregate but it has poor grading. As both the fine and the coarse aggregates are conglomerate, the stockpile will not be uniform. Drilling and blasting produces a uniform, well-graded stockpile. It was decided therefore to use the drilling and blasting procedure wherever the sources of supply were adequate.

Results are discussed as applied to the typical atoll of Fig. 1. On the above assumptions and referring to Fig. 1, the best coral should be found on island No. 4 at area "D"; the next best grade should be found on Island No. 1 at area "A." Poorer grades should be found on islands Nos. 7 and 11 at sites marked "E" and "F" respectively.

Explorations were made on the various islands. Test holes were drilled in the ocean reefs to determine the depth of the deposit and to obtain samples of aggregate for test purposes. The results of the explorations are noted in detail in Table I. These results show that the two assumptions made were sound, although they do not necessarily prove that the theory of accelerated food supply is correct.

Testing the coral aggregate

Prior to the explorations, the following assumptions were made:

1. Concrete made from corals with the higher specific gravities would be the stronger.
2. For corals having the same specific gravity, the concrete containing coral with the lowest percentage of absorption would be the stronger.

If these assumptions were correct, the following priority should be true:

Island No.	Specific Gravity	% Absorption	Rating
4	2 65	1 00	1
1	2 63	1 17	2
2	2 62	1 88	3
12	2 62	2 18	4

Test cylinders were prepared with the aggregate from the islands Nos. 4, 1, 2 and 12. The mixes were identical in all respects. A cement-factor of 5.5 was used with a water cement ratio of 0.63, and a 3-in. slump was maintained on all mixes. The results of the compression tests are shown in Fig. 2. It is interesting to note that the aggregates from islands Nos. 2 and 12 had the same specific gravity. The results indicate that the percentage of absorption has a definite relation to strength.

Quarrying and stockpiling

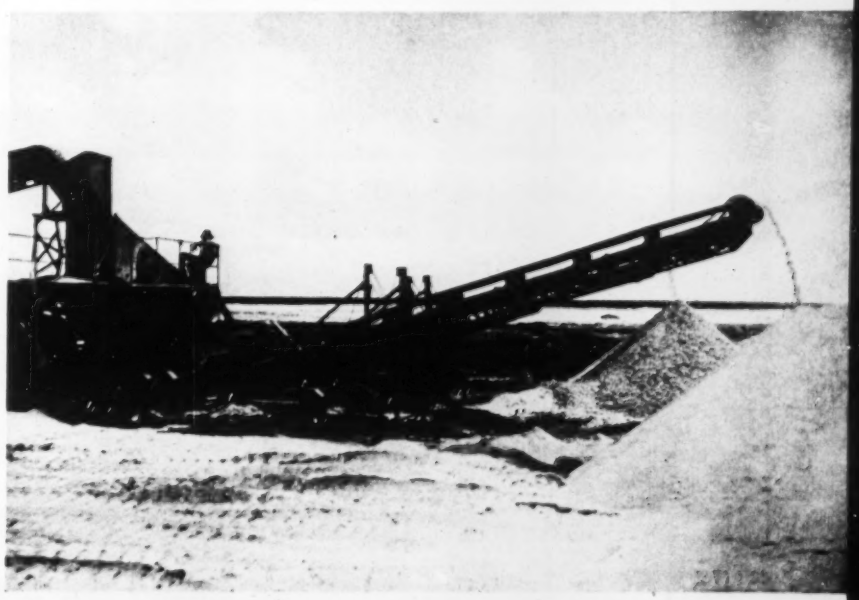
When the exploration work is completed and approved as to locations for a particular construction site, the work of drilling and blasting the aggregate is started. Drilling rigs operate with a $1^1/_4$-in. drill, making the final hole about 2 in. in diameter and the depth of the hole averaging 4 to 5 ft, spaced 3 ft on centers. The powder charge consists of two 60-percent sticks ($1^1/_2 \times 12$ in.) in each hole. These figures vary at different sites, but are fairly representative.

A crusher plant set up near the source of the rock is shown in one of the accompanying photographs. The crushing equipment consisted of primary and secondary jaw crushers with vibrating screens, the conveyor being arranged to produce two stockpiles, one

Far left:
For placing charges in coral reef, holes of 2-in. diameter, spaced 3 ft on centers, are drilled 4 or 5 ft deep. Holes are plugged, as shown, until powder charges are placed.

Left:
Samples of 1-in. coral aggregate show characteristic angular breaks from crushing. All coral aggregate, regardless of size, is similar in shape. Coral crushed in wet condition retains 5 to 8 percent fines. Note coral-dust fines in lower center of photo.

Right:
Crusher plant makes and stockpiles aggregate on a coral reef. Here conveyor is arranged to produce two stockpiles simultaneously—coarse and fine (near pile).



a coarse aggregate pile of $1^1/_2$ in. maximum size, and the other a fine aggregate pile passing the No. 4 screen. The average yield of this crusher, in nine hours, was 130 cu yd of rock and 85 cu yd of sand. The mix generally averaged 47 percent fine and 53 percent coarse aggregate, which made the stockpile slightly unbalanced. This was corrected by adding beach or pit sand to the primary crusher.

The maximum size of coral that can be used is determined by the size of the crusher. For the crusher pictured, the largest piece of coral that could be handled was 18 in. × 18 in. × 32 in. It proved more economical to quarry rock no larger than 12 in. × 12 in. × 24 in., as the larger sizes caused delay by plugging the hopper of the primary crusher.

The gradations of the coarse aggregate were easily controlled by adjusting the clearances of the jaws. The gradation of the fine aggregates could not be precisely controlled; the runs were usually deficient in material passing the No. 50, 100, and 200 screens and did not meet recommended ASTM gradation requirements.

A portion of the fines produced was usually lost because the quarried aggregate was crushed before it had an opportunity to dry. The stone going through the crusher in a very wet condition retains with the coarse aggregate about 5 to 8 percent of the fines, which are usually high on the No. 100 and No. 50 screens.

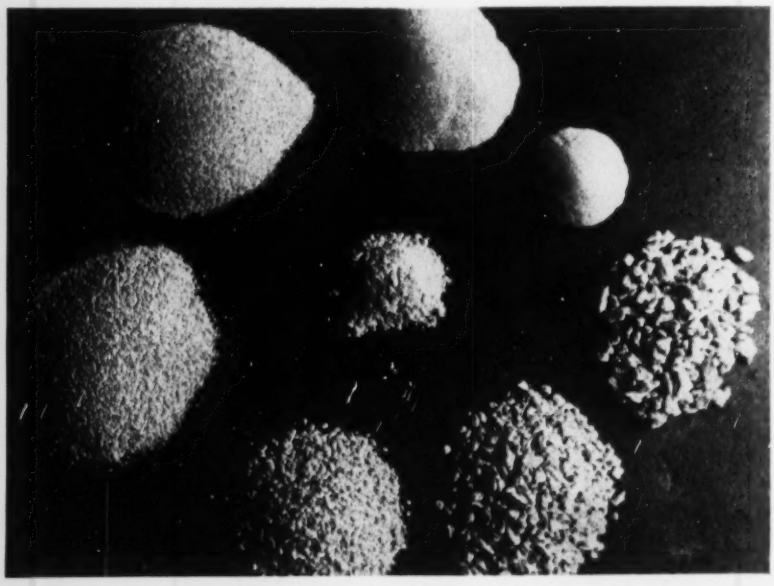
To make up for the deficiency in crusher production of fine aggregates, natural sand had to be added as previously mentioned. However, beach sands, usually found on the lagoon side, are very low in material passing the No. 100 and 200 mesh screens. The fine sands appear to stay in suspension in the waters of the lagoon; then the currents pull these fines away from the beach, and in many instances there are deposits of fines a few hundred yards from the shoreline and in two or three fathoms of water. On the lagoon side of the windward islands, it is often possible to discover dry-land deposits of these small-particle-size fines that are presumably of wave-deposited origin.

The problem of obtaining enough material passing the No. 200-mesh screen to make the concrete workable and reduce bleeding is one that developed early in the investigations. It is held by certain authorities that a small quantity of this fine material increases strength and helps keep the concrete uniform. Where they are available naturally, these fines are added with material charged to the primary crusher. When unavailable, additional cement is provided in the mix design to remedy this deficiency. It may become economical in the future to import limestone dust or other mineral fines, or to operate a small ball or hammer mill to produce material of small particle size. However, to date the complications involved when operating at many isolated construction sites do not justify such refinement. Also, modern concrete technology is now tending toward reduced amounts of aggregate passing the No. 50, 100 and 200-mesh screens to avoid high water demands and consequent loss in quality of concrete. This is particularly true of the higher-cement-factor mixes, such as are employed in the operation under discussion.

TABLE II. Gradation of coral sands

Type of Sand	Percentage Passing Screen						
	No. 200	No. 100	No. 50	No. 30	No. 16	No. 8	No. 4
Beach sand	0	0	4	30	66	90	95
Beach sand	0	0	2	11	31	81	93
Beach sand	0	2	10	50	89	96	98
Beach sand	0	0	8	90	98	99	..
Beach sand	0	0	1	23	67	96	..
Pit-run sand	0	1	11	91	99	..	..
Pit-run sand	1	2	22	44	59	75	83
Pit-run sand	0	0	10	98	..	..	..
Crusher-run sand (max.)	6	10	20	38	54	84	100
Crusher-run sand (min.)	2	4	15	42	64	84	100

Typical samples of crusher-run coral sands are segregated in piles clockwise, from screen No. 4 to screen No. 200. Center sample is composite of all fines as taken from stockpile.



The gradations of the coarse aggregates as taken from the stockpiles are given in Table II. It has been our experience that deposits of pit and beach sand that appear to be uniform will vary in gradations. A typical example was a pit deposit that varied from 12.9 to 25.5 percent retained on a No. 4 screen. Crusher-run gradations are shown in a photograph.

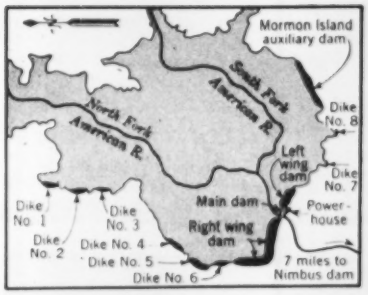
The areas in which coral aggregates are used are likewise areas of heavy rainfall. If practicable, it is desirable to protect both the fine and the coarse stockpiles from heavy rainfall. With an average rainfall, the fines in both stockpiles will wash down to the bottom of the pile. If the stockpiles are not protected, the gradations should be checked at intervals and the batch weights corrected accordingly. It is good practice to rework both stockpiles before batching.

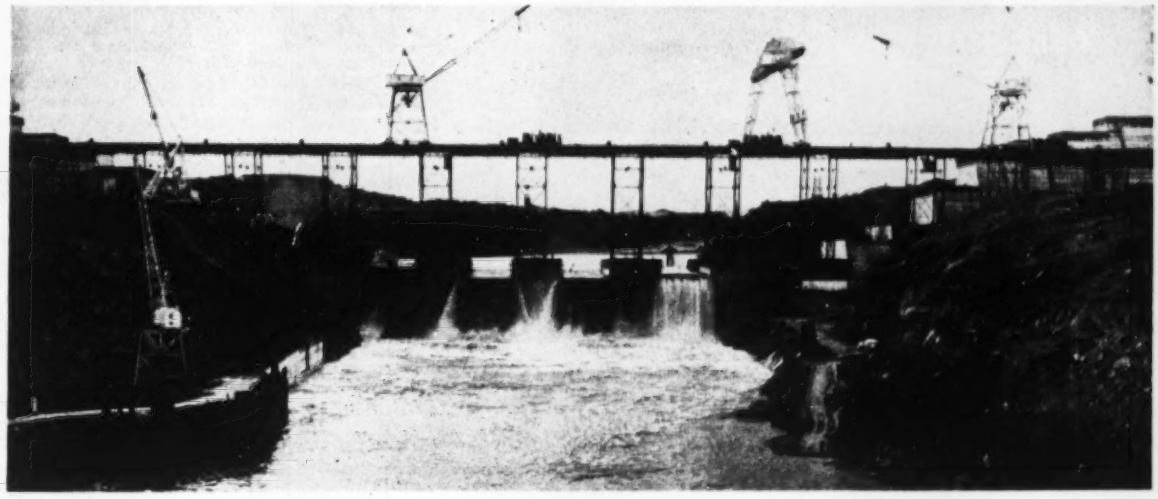
Cooperation between Corps of Engineers, entrusted with dam construction, and Bureau of Reclamation, in charge of power facilities, is significant feature of this project.

F. KOCHIS, A.M. ASCE, Chief, Engineering Division

HORACE A. JOHNSON, M. ASCE, Chief, Construction-Operations Division

Sacramento District, Corps of Engineers, Sacramento, Calif.





Flood flow passes over concrete monoliths in winter of 1954. Previous winter's floods caused considerable damage, including loss of contractor's trestle. Capacity of diversion tunnel was limited. Overtopping of cofferdam was anticipated, allowing yearly construction period of 3 to 8 months.

Faulted foundation complicates construction of Folsom Dam

The Folsom Project, a federal development consisting of a dam creating a 1,000,000 acre-ft reservoir, and power generating and transmission facilities, is located on the American River, a tributary of the Sacramento River, about 20 miles east of Sacramento, Calif. As originally authorized by the Flood Control Act of 1944, the reservoir was to have a capacity of 355,000 acre-ft, but after studies by the Corps of Engineers, the U.S. Bureau of Reclamation and the State Engineer, this was changed to a storage capacity of 1,000,000 acre-ft by Congress in 1949. The 1949 authorization was unusual in that it provided for construction of the dam by the Corps of Engineers and for construction of the power facilities, including a downstream afterbay dam at Nimbus (7 miles below) with its power facilities, as well as transmission lines, by the Bureau of Reclamation—all to be operated by the Bureau as a unit of the Central Valley Project.

The 1,000,000 acre-ft gross reservoir capacity was based on economic considerations as controlled by site limitations. Of this, about 88,000 acre-ft will be utilized to maintain a minimum power pool while the remaining 912,000 acre-ft, amounting to 9.2 in. per sq mile of controlled drainage area, will be operated in the joint interest of flood control, municipal and industrial water supply, irrigation, power and incidental recreation use. The maximum flood-control reservation, which will vary seasonally with the flood hazard, will be 400,000 acre-ft. The Folsom Power Plant will have a gross head ranging from 196 to 336 ft, and an installed capacity of 162,000 kw.

Site characteristics involved

The concrete river section of the dam is founded on fresh granite rock. The earth wing dams and eight of the saddle dikes are in general founded on decomposed granitic soils, their cutoff trenches being taken down through surface soils of relatively light density to weathered but firm granite. The largest of the saddle dikes, the Mormon Island Auxiliary Dam, has a 65-ft-deep cutoff trench excavated through alluvial deposits, a portion of which had been worked by gold dredges, to a closely jointed metamorphosed sedimentary and volcanic rock in which schist predominates. Because of the highly jointed nature of the granitic rock and because artesian water was encountered in the schist at Mormon Island, the foundations of the cutoff trenches under the earth wings and under the Mormon Island Auxiliary Dam were "slush grouted" before backfilling. Also because of the jointing, a cutoff grout curtain is also being provided under all the earth-dam sections as well as under the concrete gravity dam section.

Five main local conditions had to be taken into consideration in the design of the dam:

1. There was a 65 ft depth of mining debris in the river, consisting of silts, clays, sand and gravel deposited behind a power diversion dam owned by the Pacific Gas & Electric Co., and located some 4,700 ft downstream from the Folsom Dam site. All such debris, as

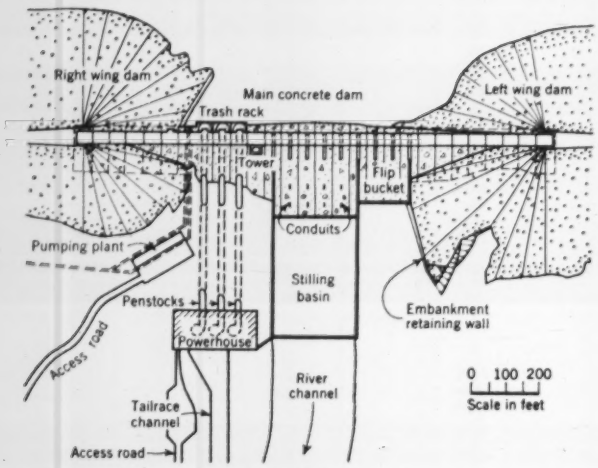


FIG. 1. (Above) Plan of Folsom Dam shows main concrete river section, enveloped at each end by wing dam, and other features of project, to be operated in joint interest of flood control, water supply, irrigation, and power.

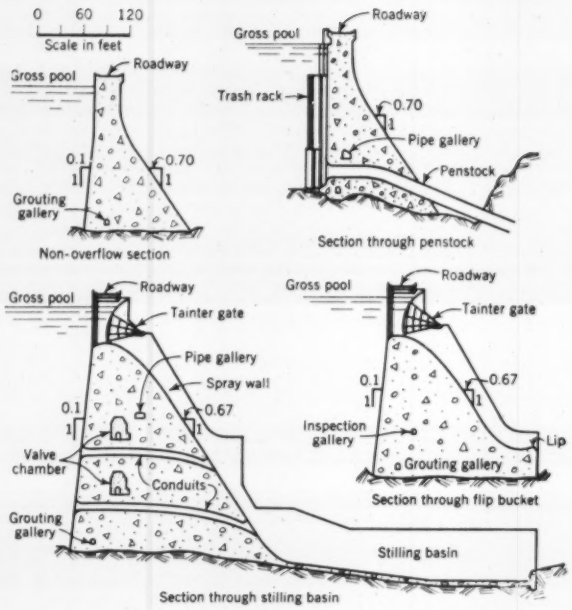


FIG. 2. (Right) Typical sections indicate design of concrete river portion of Folsom Dam.

well as the power diversion dam itself, was removed so as to drop the tailwater elevation and create additional head at the power plant. As much of this excavated material as was suitable was used for construction of the pervious section of the right wing dam. Some rock excavation was also necessary in the channel to obtain the desired tailwater lowering. Such excavated rock was used for pervious fill for the earth dams and for riprap.

2. Deep weathering of the native granitic rock required deep excavation on the concrete gravity abutments of the river section of the dam. The depth of foundation excavation on the right abutment averaged about 50 ft, and on the left abutment about 60 ft. Such weathering of the granite did, however, provide an excellent source of impervious fill, and such weathered material, obtained from borrow pits, was used as fill in the earth-dam sections.

3. There was an extensive and closely spaced joint system in the granite. The most important joint system from a design standpoint had a strike parallel to the river and a steep dip into the right abutment. Such jointing necessitated the removal of unstable rock from the left abutment which in other respects would have been suitable. The excavation line resulting from this joint system also necessitated the use of a cantilever-type stilling-basin wall on the left bank in lieu of the more economical "hang-on" type wall, satisfactorily adopted for the right bank.

4. Extensive dredge tailings, created by past operations of hydraulic gold dredges, were available and were utilized as pervious fill for the Mormon Island dike and for the left wing dam. They were also used to supplement the other sources of pervious fill for the right wing dam and as a source of concrete aggregate to supplement material from natural river bars, which were deficient in the plus 3-in. sizes.

5. On the axis of the dam, the low-water width of the river is limited to about 250 ft. Hydrologic and hydraulic studies by the Corps of Engineers indicated that, to adequately protect the dam from overtopping under an extreme, but theoretically possible combination of events, the spillway should have eight Tainter gates 42 ft wide by 50 and 54 ft in height. In the narrow river channel, only five 50-ft-high gates could be economically provided with a conventional hydraulic-jump type of stilling basin. The other three gates, 54 ft in height and a contingency provision, are located on the left abutment immediately adjacent to the main spillway section. These gates, at the time they were designed, were the highest of this type ever adopted.

The contingency gates have no provisions for dissipation of energy but do incorporate a flip bucket near the toe of the dam so that, if and when they go into operation, the impact of the spilling water will not endanger the safety of the dam. Operation of these gates would be a rare event in any case, as even without considering reduction of peak by storage or surcharge, the five main gates alone can pass an uncontrolled peak inflow of about 300,000 cfs, theoretically to be expected about once in 500 years.

Design of structures

The maximum height of the concrete river section, from foundation to roadway, is 340 ft and the combined length of the concrete overflow and non-overflow sections is 1,400 ft. About 960,000 cu yd of excavation and 1,170,000 cu yd of concrete will be required for the concrete dam and its stilling basin. All sections of the dam were designed as vertical gravity sections one foot wide, under various assumptions as to pool and tailwater elevations, uplift, and earthquake loading. No unusual design problems were involved in fixing the cross sections (Figs. 1 and 2). Each of the eight Tainter gates on the spillway crest is operated by its own individual motor-driven hoist.

The five-bay river spillway section has four 5 × 9-ft combination flood control-irrigation sluice outlets in each of two tiers. Each sluice is controlled by two 5 × 9-ft hydraulically operated slide gates in tandem, one acting as the service gate and the other as an emergency gate. An 8 × 15-ft fixed-wheel face gate is also provided to unwater the sluices for inspection and maintenance. An operating bridge and roadway are provided over the spillway section, and rails extend across the concrete dam for a gantry crane to operate the face gate and the penstock emergency gates.

The stilling basin is designed to prevent objectionable surges in the vicinity of the power plant for flood control releases up to 115,000 cfs, and to contain

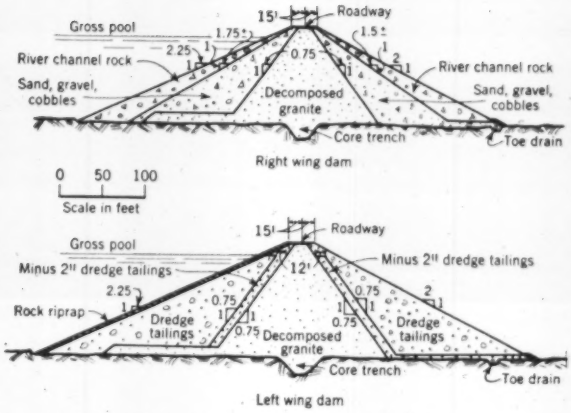


FIG. 3. (Above) Right and left wing dams both have core of decomposed granite with pervious shell.

At construction site, seen from air at right, long suspension conveyor belt transports aggregate across river to concrete plant at extreme top right. To left of this plant, monoliths of dam proper are rising under construction trestle.

the hydraulic jump for all spillway flows up to 300,000 cfs. Three 15-ft 6-in. steel-lined penstocks, controlled by fixed-wheel emergency gates, pass through the right abutment non-overflow section to serve the power plant (Fig. 1).

The concrete river section is enveloped on both ends by large earth wings having a maximum height of 145 ft, a combined length of 9,000 ft and a combined volume of about 7,800,000 cu yd. Both wing dams incorporate an impervious core with a pervious shell, separated by a transition zone of processed materials where necessitated by grading requirements (Fig. 3). The cutoff-trench backfill and the impervious zone consist of compacted decomposed granite while the pervious shells consist of natural river gravels, dredge tailings, and surplus rock from excavation. Riprap protection, from rock obtained from excavation, is provided on the water face of the wing dams. Their crest width is 30 ft, and their downstream and upstream slopes are 1 on 2 and 1 on $2^1/_4$ respectively. The sections were designed by the circular arc method of analysis with earthquake loading considered.

The Mormon Island auxiliary dam, with a maximum height of 120 ft, has a crest width of 30 ft, a length of some 4,800 ft and a volume of about 3,800,000 cu yd. The cutoff-trench backfill and the impervious core are constructed of a residual soil of relatively high clay content, formed from old terrace deposits and decomposed granite. The pervious shell, separated from the core by a processed transition zone, consists of dredge tailings. Its outer slopes vary, but in the maximum section the downstream slope averages 1 on $2^1/_2$ and the upstream slope, 1 on 3.

The eight saddle dikes have a combined length of some 12,000 ft and a combined volume of about 1,200,000 cu yd. The largest has a maximum height of 100 ft. These dikes are constructed of decomposed granite with a crest width of 20 ft, a downstream slope of 1 on $2^1/_4$, and an upstream slope, at maximum section, averaging about 1 on 3. Riprap protection is provided on the water faces of both the auxiliary dam and the dikes.

Coordination of construction

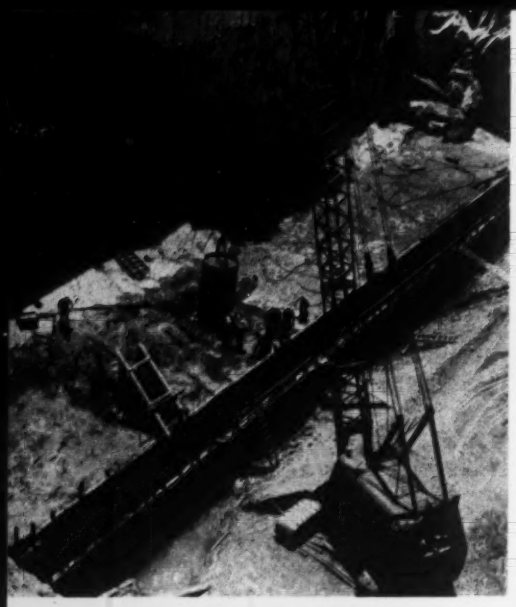
Discussion of construction will be limited to the more unusual features. Of these the most important is no doubt the special problem introduced by the fact that the dam is being constructed by the Corps of Engineers and the power plant by the Bureau of Reclamation. When this situation arose, prompt measures were taken by the Corps and the Bureau to reach an agreement on the many problems created. These problems involved primarily the design and construction of the power facilities to be incorporated in the dam; the design of the spillway stilling basin, as it concerned the design and construction of the power plant; the diversion scheme; and the funding of work to be done by the Corps of Engineers on the power features.

Agreement on all these problems was reached at a final meeting in January 1951. It was decided that the Bureau would design all the power features to be incorporated in the dam but that construction would be by the Corps of Engineers. Supply contracts were let by the Corps so as to maintain construction control of all such items in one agency. The design of the spillway stilling basin was agreed upon after performance of model tests at the Corps of Engineers' hydraulic laboratory at Vicksburg, Miss. The question of funds was settled by having the agency which was constructing the item request funds for its construction without regard to whether the item was authorized for construction by the Bureau or the Corps. These decisions were based on the fact that all the money was coming from the U.S. Treasury and that joint construction should be prosecuted in the most economical way for the Government. Cooperation between the agencies has been excellent and the desired results have been achieved.

Major utility relocation

The major utility relocation problem was the provision of water to two water companies whose diversion weirs, together with several miles of ditches below the weirs, lie within the reservoir area. The ditch of the North Fork Ditch Company runs along the right bank of the river, and that of the Natomas Company along the left bank. Both these ditches, each with a capacity of about 60 cfs, cross the dam location with a water-surface elevation of about 400, or 66 ft below the reservoir gross pool level.

Extensive studies proved that relocation of these weirs and canals above or outside the limits of the reservoir was un-



Weathered fault zone caused difficulty in left abutment foundation. After removal of questionable material, washing, and consolidation grouting, concrete is here being placed on foundation for Monolith 22. (See Fig. 4). Joint between this monolith and No. 23, in background, is being treated. Note roof bolts to prevent local fallouts.

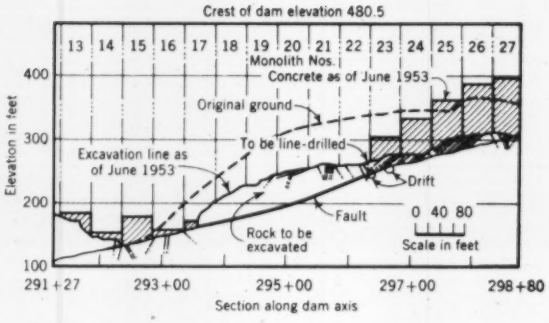


FIG. 4. Fault zone in left abutment of main concrete section, shown in cross section along axis of dam, was discovered after Monolith 23 had been started. Fault required additional excavation, bolting, and consolidation grouting.

economical and that the best solution would be to serve the ditches from the reservoir pool by a combined "gravity-pump" system. Since the minimum reservoir pool elevation is 327, it will be necessary to pump water to the ditches about 10 percent of the time. Extensive design studies proved that it would be cheaper to pass all water for these ditches, including gravity flow, through the necessary pumping plant, by bypassing the pumps, than to construct gravity-flow outlets. This solution made it necessary to provide water temporarily, but continuously, to the ditches until the pumping plant is in operation.

The solution adopted was to pass the ditches through the completed dam section in temporary conduits. For the North Fork ditch system, three 66-in. multiplate corrugated metal culverts were placed through the right wing dam. For the Natomas ditch, an unlined bypass tunnel 8×9 ft in section was driven through the left abutment of the Mormon Island Auxiliary Dam. These temporary conduits are now functioning.

The changeover from this temporary operation to permanent operation will entail some delicate timing. It is obvious that the temporary conduits must be closed before the water in the reservoir reaches their elevation, as they are uncontrolled. The changeover will consist of dropping temporary gates in front of these conduits when the water in the reservoir reaches El. 327 and concurrently placing the pumping plant in operation. Timing is critical here, as a major flood could fill the reservoir from El. 327 to El. 400 in a few days. Permanent closure will be effected by plugging the conduits with concrete. In the case of the multiplate culvert for the North Fork ditch, the entire length will be plugged. In the Natomas tunnel a plug 100 ft long will be placed near the center line of the Mormon Island Auxiliary Dam.

Diversion plan complicated

The diversion problem at Folsom is complicated by several factors, the principal ones being: (1) the drainage area is relatively small and steep and thus, from October to April, flow can go from a few hundred cu ft per sec to as much as 100,000 or more in a few hours from a rain flood; (2) snow runoff may reach 20,000 cfs or more in the early spring and persist until July 15; (3) the mining debris deposited behind the Pacific Gas & Electric Co. dam had raised the level of the bed 65 ft, thus greatly increasing the amount of excavation between the cofferdams and also increasing the seepage into this area; (4) at the dam site the working area in the river is so limited that, in combination with the deep gravels, it will not permit the use of flumes or diversion of half the river at a time.

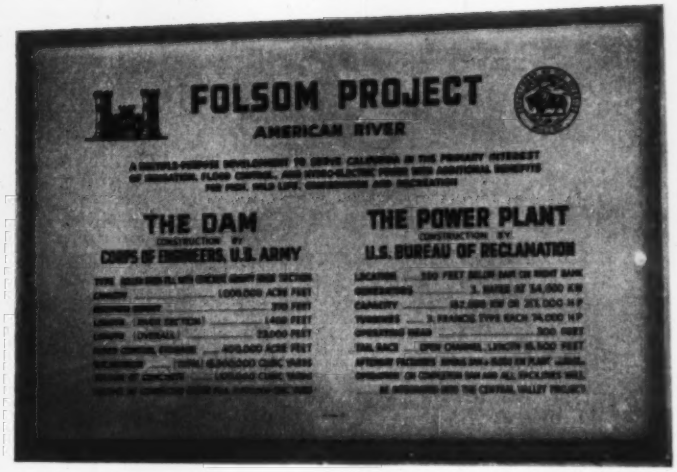
The adopted diversion plan involved the driving of a 21-ft concrete-lined horseshoe tunnel through the right abutment before the letting of the main dam contract. By agreement with the Bureau of Reclamation, this tunnel also bypasses the powerplant site and permits construction to proceed there. The capacity of this tunnel could not be made sufficient to carry the river through an average season, and overtopping of the cofferdams was expected. The capacity of the tunnel with the water surface above the upstream cofferdam at El. 237, some 30 ft above natural river elevation, is about 12,000 cfs. This gives a construction period, without overtopping of the cofferdam, varying from 3 to 8 months, depending on runoff conditions.

Driving of the tunnel was delayed by bad ground, and delivery to the main dam contractor was not made on schedule. Nevertheless, this contractor was able to make his initial diversion during the first low water in the 1952 season. The cofferdam was overtopped on January 9, 1953, and because of the deep working area in the river bottom, considerable damage was done, including the loss of the contractor's trestle. Rediversion was made in the summer of 1953 and concrete has now risen higher than the cofferdam, so that overtopping at present causes only short work stoppages and minor damage. The diversion tunnel will be left open until time to begin storing water for power generation. At that time a temporary gate will be dropped over the inlet of the tunnel. Permanent closure will be made by a tunnel plug extending the full length under the dam concrete.

In addition to the tunnel diversion, another diversion was necessary between the downstream cofferdam and the Pacific Gas & Electric Co. dam to permit the excavation of river gravels and rock from the tailrace channel. Since the invert of the tailrace channel is about 100 ft below the natural stream bed at the power plant site, this diversion was also difficult. To accomplish the diversion, a gunite-lined canal, to minimize seepage through the gravels, was constructed along the left bank from the diversion tunnel outlet to the existing power canal at the Pacific Gas & Electric Co. dam. This diversion had a capacity of about 1,500 cfs and therefore functioned only during the summer low-water period.

Fault zones create problem

Construction of the concrete section for Folsom Dam has presented several foundation problems. Exploration was



Sign explains relative roles of Corps of Engineers and Bureau of Reclamation. Cooperation between two agencies is considered most important single feature of project.

Grout mixer with capacity of 240 cu ft per hr, is used for foundation grouting of Mormon Island Auxiliary Dam, after testing by Corps of Engineers. Mark III double-drum Colcrete mixer utilizes principle of colloidal mill to prevent sand segregation.

difficult because of the weathered and jointed condition of the rock. Before the main dam contract was let, extensive exploration was carried out by core borings, and two preliminary excavation contracts were executed. These carried foundation excavation close to the expected final foundation line on the two abutments.

In spite of these precautions, during construction of the main dam a number of flat-dipping weathered zones, on which some movement had taken place in the past, were encountered in the left-abutment foundation area of the concrete river section (Fig. 4). These zones varied in thickness from a few inches to as much as 3 ft, contained some residual as well as ground-water-deposited clays, and in general dipped toward the river 15 deg and slightly upstream. They created a time-consuming problem both to appraise and define the design problem and to solve it.

The problem was solved by removing all overlying rock down to the foot wall of the lowermost fault zone, except under Monolith 23, in which concrete had already been placed by the time the fault zone was recognized. The solution under Monolith 23 consisted of partially mining out the questionable zones and replacing them with concrete, supplemented by extensive washing and consolidation grouting of the mass of the foundation rock in the vicinity.

No special problems were encountered with concrete production. Aggregate from the natural gravel and dredge tailings in the American River about 4 miles downstream from the dam site had, prior to bid opening, been determined to be of satisfactory quality. Because of the design requirement that concrete be placed at 50 deg F or less, it was necessary to install a large refrigeration plant with a capacity of 1,056 tons of ice per day.

Cement content is kept as low as possible, both for economy and to limit the heat rise in the mass. At present the cement content is 2.5 bags per cu yd for interior dam concrete. Aggregates are processed at the pit, trucked to the dam site, and transported across the river below the dam to the mixing plant on the left abutment by a suspension conveyor belt with a span of 960 ft.

Fill materials of excellent quality were readily available for the embankment. The impervious zone is constructed from decomposed granite which has an average compacted dry weight of 127 lb per cu ft. The pervious fill is composed of gravel excavated from the American River, dredge tailings, or rock excavated in the course of construction. This material is placed without moistening or compaction. The average dry density for gravels or dredge tailings is about 140 lb per cu ft.

Progress of construction

As of August 15, 1,100,000 cu yd of concrete, out of a total 1,170,000, have been placed in the main dam. Similarly, 7,500,000 cu yd of the required 8,600,000 cu yd of earth fill have been placed under the main dam contract. The dam is approximately 80 percent complete. It is planned to bring up the concrete on the two abutments rapidly so that the ends of the construction trestle can be removed sufficiently to permit placement of the wrap-around embankmeat sections during the current dry season. When this fill has been placed to full height, concrete placement can proceed as rapidly as possible. The river monoliths must be kept from 50 to 70 ft below the top of the enveloping embankment at all times to safely pass possible floods.

Barring unforeseen difficulties, concrete should be high enough so that storage of water can start in the spring of 1955. This coincides with the scheduled placing on the line of the first unit of the power plant under construction by the Bureau of Reclamation. The dam should be virtually complete in the fall of 1955, in time to provide flood protection during that flood season.

Project costs

The latest revised estimate of cost (June 30, 1954) for the dam and reservoir, and such part of the authorized power features as are being constructed by the Corps of Engineers, is summarized as follows:

Lands and damages	$ 2,623,000
Relocations	4,391,000
Reservoir and pool preparation	858,000
Concrete river section and wing dams	46,862,000
Mormon Island Auxiliary Dam	4,919,000
Saddle dikes	1,730,000
Tailrace excavation	3,567,000
Miscellaneous	450,000
Total	$65,400,000

Construction of Folsom Dam is under the direction of Col. William J. Ely, District Engineer, Corps of Engineers, Sacramento, Calif. The Sacramento District is a unit of the South Pacific Division of the Corps of Engineers located in San Francisco, Calif. Col. P. D. Berrigan, M. ASCE, Corps of Engineers, is the Division Engineer. The main dam and its earth wings are being constructed by the Savin Construction Corp. and Merritt-Chapman & Scott Corp., a joint venture, with headquarters in New York, N.Y.

(This article was prepared from the authors' paper presented at the Pacific Southwest Conference of Local Sections at Sacramento, Calif., held April 28–May 1, 1954.)

Concrete overlay on airfield pavement solves

H. R. HALLOCK, M. ASCE, Colonel, Corps of Engineers, U.S. Army; student, Army War College,

Designers of airfield pavements have long been plagued with the difficulty of providing for the increasing wheel loads and landing speeds of the complex aircraft now in production and on the drawing boards of the rapidly developing aircraft industry. Frequently a pavement is designed for a specific type of aircraft with a maximum wheel loading, but even before actual construction is completed, the landing field is called on to handle still heavier planes. This problem is particularly critical in the design and construction of pavements for military aircraft, where the development of heavier planes is extremely rapid. Since criteria for military airfields are generally rigidly prescribed, it is often difficult to justify any overdesign for possible future requirements. Therefore, in the interest of economy, and to insure minimum interruption of operations, the use of pavement overlays has become widespread on military airfields.

During World War II a large number of airfields were built in the eastern part of England for the U.S. Air Force. Most of these were constructed by the British Air Ministry in accordance with a standard design which had anticipated wheel loadings no heavier than the British two-engine Wellington Bomber. This design called for only 6 in. of concrete pavement on a prepared subgrade, and rapidly proved to be inadequate for our much heavier B-17's and B-24's.

In the spring of 1942, U.S. Aviation Engineer troops were brought to the United Kingdom and given the mission of constructing additional airfields. These were built in accordance with Air Ministry development plans and specifications, with the exception that the pavement thickness was increased to 8 in. It soon became apparent that the four-engine B-17's and B-24's could not operate very long from either the 6-in. or 8-in. pavements without causing large-scale failures. These failures were most evident in taxiways and hardstands, but were also prevalent in the touchdown areas at both ends of the runways.

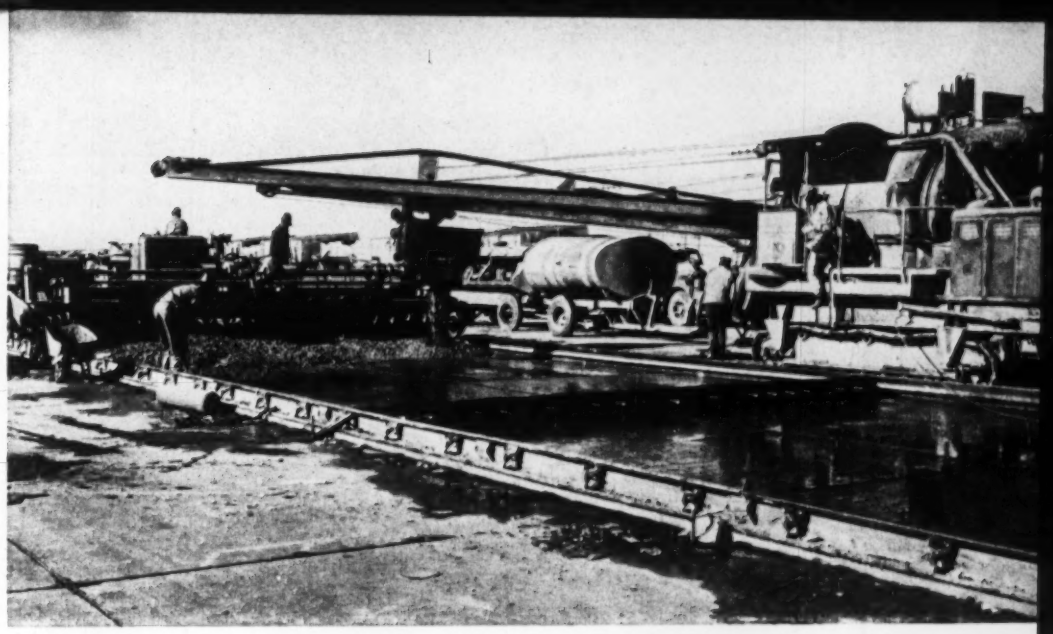
By the fall of 1943, U.S. Aviation Engineer personnel were assigned to each Air Force installation with the mission of carrying out emergency maintenance and repair of pavements. This was primarily done by removing sections of concrete which had failed and replacing them with 8 in. of high, early-strength concrete. Areas adjacent to these repaired sections had a tendency to break off, probably because of exposure of the adjacent subgrade area to the elements. At the same time crews were busy on all fields pouring joints and cracks with bituminous material to decrease penetration of surface water and reduce subgrade failures. While this work undoubtedly had some beneficial results, it did not materially retard the rapid disintegration of the pavements. It soon became evident that it was impossible to keep the airfields operating with this type of emergency work.

Ultimately it was decided to overlay the taxiway and touchdown area of the principle runway with 8 in. of concrete at about six stations of the Eighth Air Force. Although somewhat expensive, this method eliminated further maintenance on these airfields and provided an adequate pavement.

Problem at Carswell Base

A similar situation arose at Carswell Air Force Base at Fort Worth, Tex., when B-36's started using the runways, taxiways, and parking apron which had originally been designed for B-24's (Fig. 1). Deterioration of the parking apron had progressed to such an extent that an item of $3,162,000 for concrete overlay of the existing apron was authorized in the 1953 fiscal-year program. Here again the problem was complicated by the necessity for keeping this vital installation operational during the overlay program.

Since World War II, considerable information had been gathered on pavement overlay by observing the behavior of completed projects, and from extensive tests conducted by the Corps



← Where bonding is required, existing concrete pavement is sandblasted to remove grease and oil drippings before placing of concrete overlay.

→ Concrete overlay is placed on existing pavement at Carswell Air Force Base.

problem of heavier aircraft

Carlisle Barracks, Pa.; until recently, District Engineer, Fort Worth, Tex.

of Engineers. Much of this testing has been performed by the Corps' Rigid Pavement Laboratory at Lockbourne Air Force Base and at Sharonville, Ohio. Future testing and evaluation of various rigid and flexible pavement overlays at various installations are scheduled during 1954.

At Carswell Air Force Base the exact extent of the overlay area was first discussed with the using service, and the problems of providing utility service to the wing docks and the aircraft operational problems were solved. It was necessary to reduce the extent of the overlay originally proposed in the vicinity of the hangars, fire station, and other structures to provide for adequate drainage away from these buildings. It was decided to include in the work the relocation of certain wing docks, provide necessary permanent and temporary ramps, install electrical banks, and raise existing utilities. Operations had to conform with a prescribed pattern which had been approved by the Base Commander so that sufficient areas would be maintained at all times for the parking of the B-36's.

It was evident that the construction would be further complicated in that the contractor would not be able to pave in the most economical manner, using long lanes, but would have to govern his operations by the more important criterion of keeping the base in operation.

The apron surface which it was finally decided to overlay consisted of 396,200 sq yd. About 223,000 sq yd of the overlay are of 10-in. concrete, 41,700 sq yd are of 15-in. concrete, and 131,300 sq yd are in a transition section between the 10- and 15-in. thicknesses (Figs. 2 and 3). Pavement design was for a wheel load of 100,000 lb supported on dual wheels spaced 37 in. center to center, each wheel with a tire contact area of 267 sq in.

A complete condition survey of each paving lane was made to determine the extent of cracking and failure. This survey revealed that practically every slab of the 6-in. concrete was cracked to some degree and that, with the exception of a few small areas, the 10-in. pavement was in fairly good condition. Numerous concrete patches in the apron had been made by the Base Air Installations Officer over a period of years and, in addition, all the 6-in. pavement and parts of the 10-in. pavement had been undersealed with a low-penetration asphalt.

Detailed cross-section elevations of the apron were obtained to determine the drainage pattern of the existing apron and to locate local depressions. Test slabs were cut out and removed at various locations. Subgrade bearing tests were performed to determine the

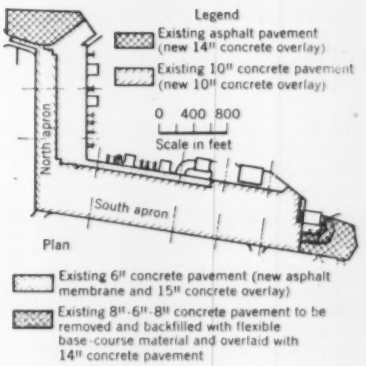

Legend
Existing asphalt pavement (new 14" concrete overlay)
Existing 10" concrete pavement (new 10" concrete overlay)
0 400 800
Scale in feet
North apron
South apron
Plan
Existing 6" concrete pavement (new asphalt membrane and 15" concrete overlay)
Existing 8"-6"-8" concrete pavement to be removed and backfilled with flexible base-course material and overlaid with 14" concrete pavement

FIG. 1. Pavement at Carswell Air Force Base, Fort Worth, Tex., showed rapid disintegration when B-36's started using runways designed for B-24's. Areas strengthened with concrete overlay are indicated.

average K value of the subgrade. Four 30-in. plate bearing tests were made on the subgrade material directly beneath the pavement. Test slabs were cut out at various locations and sent to the laboratory to determine the best method of removing the accumulation of grease and oil from the surface to guarantee bond with the new concrete overlay.

Computing overlay thickness

The formula recommended by the Corps of Engineers to compute the thickness of overlay, considering bond between the slabs, is

$$d_c = \sqrt{d^{1.87} - Cd_e^2} \quad \ldots \quad (1)$$

in which

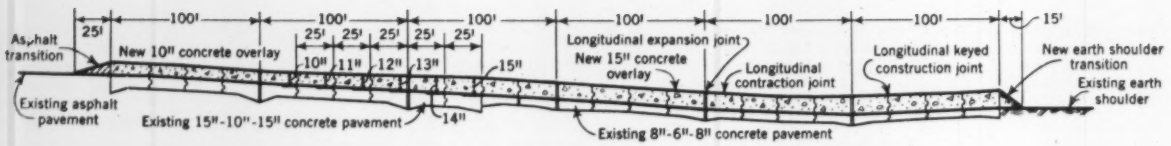


FIG. 2. New 10-in. concrete overlay rehabilitates old 6-8-6 pavement on military airfields.

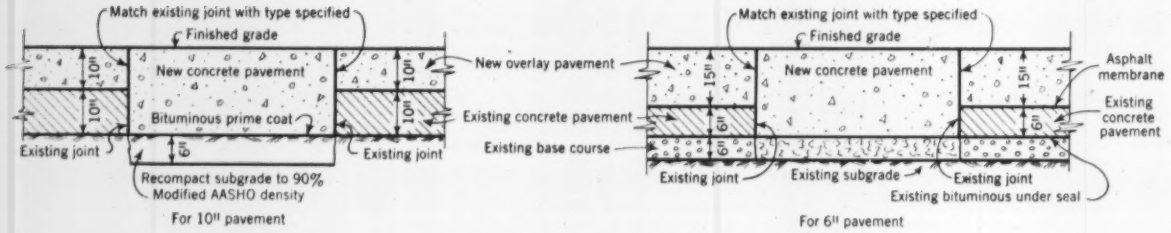


FIG. 3. Method of replacing shattered slab in old concrete airfield pavements, and matching with new concrete overlay, is illustrated for existing 6-in. and 10-in. pavements.

d = thickness of equivalent single slab placed directly on the foundation
d_c = thickness of overlay slab
d_e = thickness of existing slab
C = coefficient representing condition of existing pavement

If bond is not expected between the slabs, then d^2 in lieu of $d^{1.87}$ should be used. In determining the value of d from the design charts, the concrete in the equivalent slab was considered to have a flexural strength of 650 psi at 28 days. This was in conformity with specifications for the concrete actually placed in the overlay.

It is obvious that a formula of this nature can be easily applied to any established conditions, but on an actual overlay project the conditions of the existing slab vary greatly throughout the paving area. It is therefore necessary to fit the various conditions encountered within the limits imposed by the drainage pattern and construction methods.

At the Carswell base, the existing apron area to be strengthened included a 6-in. concrete pavement on a 6-in. selected base course; a 10-in. concrete pavement resting directly on the clay subgrade; and a 4-in. asphaltic concrete on 6 in. of crushed-stone base-course over 24 in. of a gravel subbase course. Consequently there were three basic designs to be considered, and each design presented various details to be resolved. In Eq. 1 the coefficient C, representing the condition of the old pavement, was considered as 0.75 for the 6-in. pavement and 1.00 for the 10-in. pavement. These values were assigned from the data obtained from the crack survey of the entire overlay area.

The thickness of the equivalent slab required (d in Eq. 1) was determined by computing the modulus of subgrade reaction from the bearing tests described above. The thickness of pavement was then determined for a 100,000-lb gear load supported on dual wheels spaced 37 in. center to center by using design criteria contained in Part XII, Chapter 3, of the Corps' *Engineering Manual*. The uncorrected modulus of subgrade reaction (Ku) averaged 156. The corresponding corrected value (k) averaged 109. The natural moisture content of the subgrade beneath the pavement ranged from 12.9 to 20.7 percent. Optimum moisture content was determined to range from 9.5 to 14.4 percent. It was decided to use a K value of 100 under the 6-in. and 10-in. pavements. A K value of 300 was determined for the new apron pavement designed to overlay the existing asphalt aprons.

Three design areas

Using the above data and other information contained in subsequent parts of this analysis, the concrete overlay thickness was determined as follows for the three types of design areas:

1. On the 6-in. concrete:

$K = 100$

90-day flexural strength of concrete = 720 psi

There will be no bond between existing and overlay slabs.

In the formula, $d_c = \sqrt{d^2 - Cd_e^2}$, C is assumed to be 0.75 (existing pavement with initial cracks but no progressive cracks).

$d = 16.1$ in.

$d_c = \sqrt{(16.1)^2 - 0.75(6)^2} = 15.25$ in.

From the above determinations it was decided that the portland cement concrete overlay on the existing 6-in. pavement would be 15 in. thick.

2. On the 10-in. concrete:

Assume the coefficient C in the formula $d_c = \sqrt{d^{1.87} - Cd_e^2}$ to be approximately 1.0 and use d_e as 10 in. Then $d_c = \sqrt{16.1^{1.87} - (1)(10)^2} = 9.1$ in. It was decided that the portland cement concrete overlay on the existing 10-in. pavement would be 10 in. thick, because the degree of bond to be expected with the old pavement was questionable.

3. On the asphaltic concrete apron area:

A K value of 300 was determined, which permitted a 14-in. overlay on the asphalt apron area. Some sections of the overlay pavement were designed of variable thickness to provide a transition from the 15-in. to the 10-in. overlay and still secure adequate drainage of the apron area.

Each design area was then reviewed to determine what corrective action would be necessary in substandard areas to bring them up to the average. All badly shattered panels in the 6-in. slab were designated to be removed

Badly shattered slab panels on existing apron are removed before concrete overlay is placed. Joints of new slab are matched with old. See Fig. 3.

and replaced. When the old slabs were removed, the exposed select base or subgrade was sealed with bituminous material for protection during construction.

During the design stages of this project the central part of the existing 10-in. apron continued to deteriorate because it was continually used as a taxiway for B-36 aircraft. In this critical area, certain slab panels were designated to be removed, as they were badly broken. Other panels that had one or two major transverse and longitudinal cracks but were not otherwise damaged, were given special attention. Before placement of the overlay pavement, the major cracks were immobilized by steel wedges, placed about 30 in. apart, and mortar from the overlay concrete was vibrated into these open cracks during placing operations. It was believed that this immobilization of major cracks would minimize the tendency for them to be reflected into the overlay slab. Critical areas of the existing 10-in. apron were also undersealed to correct subgrade conditions where pumping had been evident.

It was not known whether the major longitudinal and transverse cracks in the 6-in. pavement would be reflected into the 15-in. overlay. Since bond was not desired in this overlay area, it was decided to apply an asphaltic membrane over the 6-in. pavement before placing the overlay. The membrane would prevent bond between the slabs and minimize any tendency toward reflective cracking.

Joints were sealed with a jet-fuel-resistant sealing material. The joint pattern of the overlay pavement was designed to match that of the existing pavement to eliminate as much uncontrolled cracking as possible. See Figs. 2 and 3.

In areas where bonding was required, parts of the existing concrete pavement had to be cleaned of grease and oil drippings by sandblasting. Excess joint filler on the surface of the existing concrete apron was removed flush with the surface of the apron. All loose concrete adjacent to joints and in shattered slabs was removed before construction of the overlay.

Permanent transitions were designed from the overlaid apron to the existing taxiways, hangars, and other structures. These transitions, to be used by aircraft, were constructed of hot-mix surface course on a filler course of bituminous hot-mix binder.

The drainage pattern of the apron area was not changed as part of the strengthening project except for minor revisions in the vicinity of hangars and fire station. The existing apron was internally drained along a line 50 to 100 ft from the back edge. Surface water was collected by a system of inlets and discharged through a storm sewer system into the natural water courses in the cantonment area. A part of the north apron drainage is discharged by a paved ditch.

Sandblasting and cleaning of grease and oil from areas where aircraft had been parked proved more difficult than had been expected, and the extent of the underseal required was considerably more than had been anticipated. During the actual construction of this apron overlay, normal construction problems have been encountered. The contractor initially had difficulties in obtaining a uniform finish and meeting the $^1/_8$-in. tolerance in straight-edge tests at construction joints. Furthermore, the presence of buildings at the end of pavement lanes made it difficult to remove finishing equipment from completed surfaces. The difficulties in meeting the specifications at dummy joints were eliminated by the use of sawed joints.

The contractor also had considerable difficulty in maintaining proper alignment of forms. Initially the forms for the 15-in. sections consisted of an 8-in. steel form built up with 2-in. and 3-in. timbers 8 in. in width. It was decided that this form did not provide sufficient lateral stability, and the contractor was required to have the bottom timber equal in width to the total height of the form, and all timbers were bolted to the steel form.

Construction is nearing completion under a $1,985,000 contract with Nolan Brothers, Inc., of Minneapolis, Minn. The 15-in. overlay on the asphalt apron on the north end and the overlay on the north half of the main apron have been completed and are in use. Coordination with base operations has proceeded smoothly. It is believed that the final product, which is scheduled for completion early this fall, will be a thoroughly usable, durable apron for the home of our strategic bombers.

Reinforced brick masonry chosen for California

ROY E. GUARD, Chief, Architectural Division, Technical Services, Veterans Administration, Washington, D.C.

While reinforced brick masonry has been used extensively in California and other areas where high resistance to lateral force is required, the Sepulveda Veterans Administration Hospital, consisting of more than 245,000 sq ft of reinforced brick walls, is probably the largest single project of this type ever built in the United States.

This hospital is a 1,000-bed neuropsychiatric center located in the San Fernando Valley just outside of Los Angeles at Sepulveda, Calif. The project, which was started in the early fall of 1952, is now nearing completion and is expected to be ready for patients in the spring of 1955. The complete hospital, which will cost more than $20,000,000, is modern in every detail and will have the very latest equipment and related features in order to provide the best possible psychiatric and medical care for all classes of the mentally ill.

On the site, consisting of about 175 acres, more than 26 buildings will be built, ranging from the huge six-story general medical and surgical building to one-story structures for the housing of hospital personnel. The general contract for the work was awarded to the Gust K. Newberg Construction Company in August 1952.

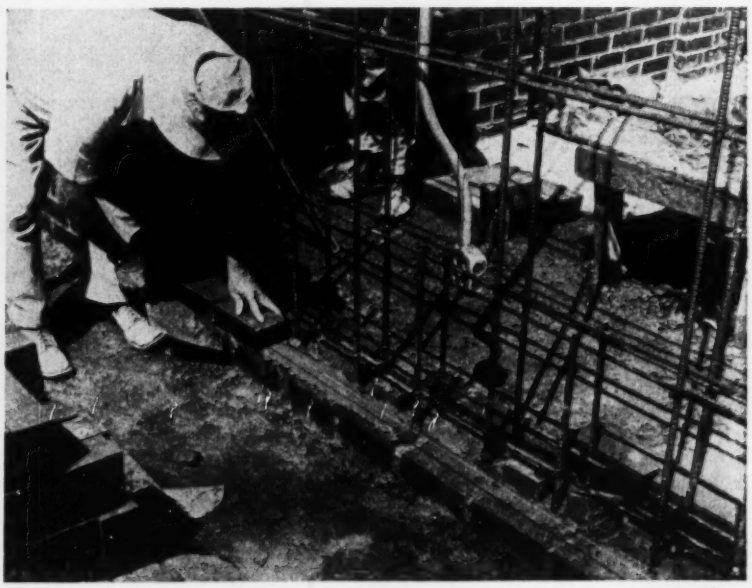
Before any designs for the various buildings were started, considerable study and research was carried out by the architects and engineers employed by the Veterans Administration to determine the most suitable materials consistent with the requirements of a hospital of this character, with climatic conditions, and with local surroundings. Color harmony in the selection of materials was considered of great importance because of its psychological effect on psychiatric patients. It was also desired to secure a harmonious composition and building design requiring a minimum of upkeep and maintenance. As a result of these studies, brick was selected as the exterior facing material, the taller buildings to have a reinforced concrete skeleton frame with a concrete panel wall faced with brick, and the remaining buildings to be of reinforced grouted brick masonry.

Reinforced brick masonry is brick masonry in which steel reinforcing is embedded, so placed as to provide greatly increased resistance to forces which produce shearing, tensile, and compressive stresses. The principles of reinforced brick masonry design are the same as those commonly accepted for reinforced concrete, and similar formulas may be used.

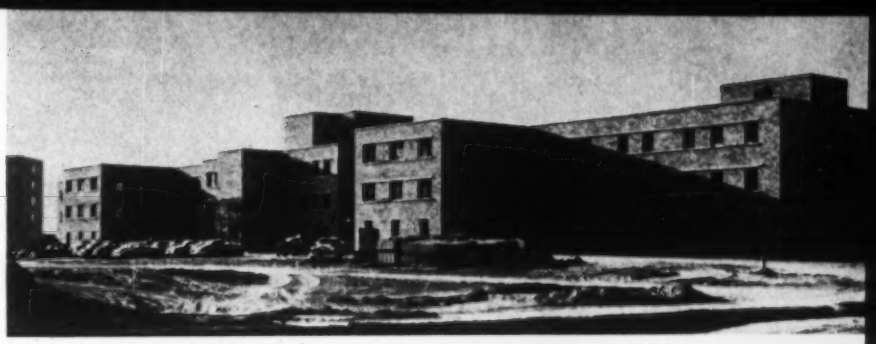
To insure complete embedment of the reinforcement, the specifications for the Sepulveda Hospital required that all interior joints be filled with grout consisting of mortar to which sufficient water has been added to give it a fluid consistency.

In the design of the hospital, the working stresses prescribed in the 1951 edition of the Los Angeles City Building

Cement grout is poured in center of wall (below, left) when inner tier of brick has been built up three courses, exterior tier, one course. Center is poured full so that middle tier of brick is floated in grout. Head and bed joints of inner and outer courses must be completely filled. Masonry is built up around reinforcing steel with care (below, right). Starter course is being placed on second floor, using standard-size brick on face of 13-in. wall and oversize brick in center.



V.A. hospital



Typical structure at Sepulveda Veterans Administration Hospital is tuberculosis and neuropsychiatric building No. 10.

Code were used. These stresses are somewhat more conservative than other recommendations. However, for one- and two-story structures, working stresses are rarely critical factors in earthquake design, since the minimum reinforcement and wall thickness requirements usually control.

Working stresses prescribed in the Los Angeles Code are based on f'_m, the compressive strength of masonry prisms, and are shown in Table I.

In the construction of reinforced brick masonry walls, the steel reinforcement is tied in place, after which the brick in the outer tier or wythe is laid up for not more than 3 courses. In a 12-in. wall, the inner wythe is then laid up one course, and the space between the wythes filled with grout in which the brick for the center wythe are floated. Specifications provide that all brick be laid with full head and bed joints.

The Uniform Code of the Pacific Coast Building Officials Conference was used for earthquake design requirements in determining the horizontal static forces which the buildings were designed to resist. For seismic Zone 3, in which Sepulveda is located, these forces are obtained from the formula, $F = CW$, in which F is the horizontal force in pounds; W, the total dead load tributary to the point under consideration; and C, a numerical constant. This constant, C, is obtained from the formula $(0.60/N) + 4^1/_2$, where N is the number of stories above the story under consideration. For bearing walls and partitions, $C = 0.20$ with a minimum of 5 psf; and for parapet walls and ornamentations, $C = 1.0$.

As previously indicated, the calculated stresses based on these loads are rarely critical in one- and two-story structures. However, surveys of damage to buildings from past earthquakes indicate that one of the principal causes of damage is the failure of connections. Earthquake motion is violent and chaotic and, since a building has many degrees of freedom, all its parts must be securely tied together so that it will act as a unit under severe lateral motion, together with vertical motion. For this reason, careful study was given to the details for columns, lintels, and walls to insure that all parts of each building would be properly tied together.

The contractor's superintendent stated that the production of his masons was unaffected by the necessity of working with reinforcement.

The exterior brickwork on all buildings is a rose-tan color which is enhanced through the use of varying amounts of ceramic veneer. This material, together with glazed facing tile, is used extensively in the interiors.

Sepulveda Hospital, as constructed by the Veterans Administration, is considered one of the most modern in the United States for the care and treatment of patients physically and mentally ill.

Bond beams in Sepulveda Hospital buildings are constructed wider than wall below by using brick corbels to hold plank, which forms bearing for soffit of bond-beam overhang. When set, brick corbels are cut off and plank removed.

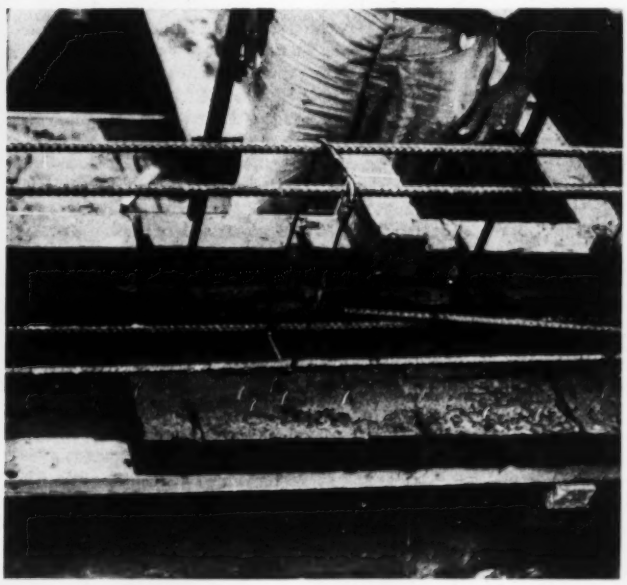


TABLE I. Working stresses prescribed in Los Angeles Building Code

Type of Stress	For Any Strength of Brick Masonry, f'_m in psi*	Values Used for Sepulveda Design Based on f'_m = 1,500 psi for Brick Used†
Compression, axial	0.18 f'_m	270
Compression, flexural	0.33 f'_m	500
Shear		
No shear reinforcement	0.015 f'_m	22.5
With properly designed shear reinforcement taking $^2/_3$ of entire shear	0.033 f'_m	50
Bearing	0.25 f'_m	375
Modulus of elasticity	1,000 f'_m	1,500,000
Modulus of rigidity	400 f'_m	600,000
Bond type A-1 grout		
Plain bars	80	80
Deformed bars	100	100

* Working stresses in this code are based on f'_m, compressive strength of masonry prisms, in pounds per square inch.

† Values in this column are based on a masonry strength of 1,500 psi, and are the values used for the Sepulveda design. Grade "M W" (2,500 psi) brick was used, and f'_m was assumed to be 60 percent of the brick strength.

Obvious problem takes years to solve

The Raritan River was made famous many years ago by the loyal sons of ivied Rutgers University, who made the strains of "On the Banks of the Old Raritan" echo throughout the world. In more recent decades, the Raritan as well as Raritan Bay into which it empties, has become notorious in the sanitary engineering field, and has occupied the time of many consultants from near and far. However, it is hoped that, with the execution of plans now under way, the river and bay will become, if not of pristine purity, at least useful and not a nuisance.

The Raritan is the largest intra-state river system in New Jersey, with a drainage area of 1,105 sq miles, and Raritan Bay is a part of the waters of the New York metropolitan area. The river flows through rural areas and is subject to relatively little pollution until it reaches a point about 25 miles upstream from the bay. In this 25-mile lower stretch, 18 miles of which is tidal, the river is intensely polluted by municipal and industrial waste.

The Raritan is "flashy," the upper drainage area being hilly, the lower flat. Rapid runoff follows heavy rains and flooding is common. The freshwater flow varies from about 2 percent of the average to 50 times the average. Normal low flows in late summer and early autumn give rise to critical pollution problems. At times of extreme low flow, just above the upper reaches of the tide, the dilution factor for wastes now discharged is not more than 1 to 1.

In the lower Raritan Valley population in the late 1920's was estimated at 175,000, in 1950 at 350,000. The population equivalent of the industrial wastes discharged into the lower valley in the late '20's was estimated at 85,000, in 1950 at 765,000.

The fact that the Raritan was to become a pollution problem was recognized as long ago as 1909, when the old New Jersey State Board of Health issued an order against the City of New Brunswick to cease pollution of the river. Plans were prepared for a sewage treatment plant, but it was not built. The probability that the river would become a detriment rather than an asset to adjacent communities was recognized by a small group of citizens, particularly leading industrialists, in the mid '20's, when a preliminary bacteriological survey was made by Rutgers University. This demonstrated for the first time what everyone concerned already knew—that the river was polluted.

In the late '20's the Port Raritan District Commission, under the leadership of its chairman, Russell E. Watson, contracted with Rutgers University to make a more extensive chemical and biological survey. Findings confirmed the previous ones in greater detail. Then the Commission obtained an appropriation of $15,000 from the State Legislature for an engineering survey, made by the firm of Remington, Vosbury & Goff of Camden, N.J. This survey concluded that construction of a trunk sewer should be postponed until such time as it might be required by population increase; that individual or joint plants should be constructed by the several municipalities; and that industrial wastes should be treated by the industries concerned. These recommendations were given wide publicity in the hope of initiating a planned solution to the problem, but nothing materialized.

The State Department of Health had recognized the problem, but had been helpless because of limited personnel until it received a special appropriation of $25,000 for the State Legislature in 1930, which enabled it to execute a comprehensive survey. During the economic depression of the 30's the Department issued formal orders against 17 municipalities requiring that they cease pollution of the river. But these municipalities were in grave financial difficulties and were granted a two-year extension of time. They agreed to enter consent decrees in the State Court of Chancery. At the expiration of the two-year period their financial condition had not improved, and they did not comply with the orders.

In 1933 the Federal Public Works Administration made financial assistance available to the municipalities. Only one of them proceeded on its own initiative. The failure of the other municipalities obligated the State Department of Health to get the Attorney General of the State to issue court decrees in April 1935. As a result, all the municipalities constructed sewage treatment plants, most of which were placed in operation from 1937 to 1939.

By 1939 it was estimated that the domestic sewage treatment plants had reduced the B.O.D. by 53 percent; the suspended solids by 71 percent; and the coliform bacteria density by 99.9 percent. In 1940, when the sewage flow from the municipal plants had increased to 26.8 mdg, 19 new and remodeled treatment plants were in operation. This was only five years after the court decrees were obtained. A survey at that time showed that the suspended solids removal at the treatment plants averaged 80 percent, and the B.O.D. removal, more than 50 percent.

It was becoming more and more apparent that industrial wastes were playing an important role in the pollution of the river. World War II interfered with progress in pollution abatement, particularly by industry, but stimulated industrial expansion far beyond anything previously anticipated. Immediately after World War II the State Department resumed its positive program for stream pollution abatement, particularly by industry. By that time some of the sewage treatment plants were already overloaded and action against the municipalities concerned was found necessary. In 1946 legal proceedings were instituted against municipalities and industries.

The industrial waste problem had been a complicated one from the beginning. By 1946 it had become a special concern of the Industrial Commissioner of Middlesex County. Earlier, in 1938, the State Department of Health was obliged not to approve the discharge of any further wastes into one of the river's smaller tributaries. This happened to be in one of the most desirable sections for industrial expansion. This fact, together with the general industrial expansion of World War II, emphasized the problem. The Industrial Commissioner was responsible, together with other civic leaders, for interesting the Middlesex County Planning Board.

This board, under the leadership of its chairman, George F. Smith, em-

ROBERT S. SHAW, Chief Public Health Engineer, New Jersey State Department of Health, Trenton, N. J.

ployed a consulting engineer, Elson T. Killam, M. ASCE, to make a preliminary engineering investigation. It also engaged the Department of Sanitation of Rutgers University and the Wood's Hole (Mass.) Oceanographic Institution, which last made studies of the natural movement of currents in Raritan Bay and their effects on the dispersion of an effluent discharged at various points.

The State Department of Health had followed these developments closely, and in response to pleas from the valley, agreed to delay legal proceedings in order to give the interested parties a full opportunity to explore a joint project such as a trunk sewer and treatment plant at the lower end of the valley. Such a project had been abandoned in 1929 and 1930 because the valley had not grown up sufficiently to support it. After the various surveys by the Middlesex County Planning Board in 1947 and 1948, it became evident to the State Department of Health and to practically all leading citizens, including municipal officials and industrialists, that a trunk sewer project was not only feasible but was actually the only sound ultimate solution.

Time marched on. There was the usual anticipated controversy among neighboring municipal and county officials. By early in 1950 the State Department of Health was obliged to doubt whether positive action was going to be taken. The State Commissioner of Health, aware of the recommendation of the planning board that the Board of Freeholders of Middlesex County appoint a sewerage authority, issued an edict that failure to appoint such an authority by June of 1950 would obligate the State Department of Health to resume its legal proceedings against individual municipalities and industries. In July 1950, the Board of Freeholders appointed the Middlesex County Sewerage Authority.

The Authority employed consulting engineers to conduct studies and make cost estimates for a trunk sewer project. They also employed the services of Rutgers University in collaboration with the State Department of Health to make an up-to-date survey of the river and bay. At that time, 1950, more than 103 million gal of sewage and industrial wastes were being discharged into the lower river daily, 37.5 mgd from municipal sewer systems, including some industrial wastes, and 65.5 mgd directly by industries.

Pollution has had a two-fold effect on Raritan Bay. The State Department of Health had been obliged to declare the bay beaches unfit for bathing, so that property values depreciated. A tremendous shellfish industry was lost, at least for the time being, since most of the bay had been condemned for the taking of shellfish.

The Middlesex County Sewerage Authority conducted an intensive educational campaign throughout the valley, met with the governing bodies of municipalities and industries, and after many months of study and negotiation, promulgated contracts for consideration by these bodies. But in Somerset County, above the tidal section of the river, two major industries and three municipalities objected to the contracts as offered. This difficulty resulted in more months of conferences and bickering.

It finally was decided that the Middlesex County Sewerage Authority would move to solve its own problems with limited participation by a part of neighboring Union County and two of the lower Somerset County municipalities. The project was altered and new contracts were drawn. After more months of negotiation, the Authority finally secured the signatures of all the important participants. From that time on the project became one of execution, financing, engineering, etc. [See Mr. Chase's article, which follows.]

In the meantime the State Department of Health was confronted with the problem of what to do about the industries and municipalities in the upper end of the lower valley in Somerset County, which originally had been included in the Middlesex County Sewerage Authority project. The only logical move was legal procedure. After court proceedings were instituted, these municipalities and industries committed themselves to a solution of their respective problems, either individually or collectively. In the meantime a group known as the Somerset County Citizens' Committee, made up of representatives of the interested municipalities and industries, instituted a study, employing Sheppard T. Powell and Whitman, Requardt & Associates, consulting engineers from Baltimore. In brief, they recommended the establishment of a Somerset-Raritan Valley Sewerage Authority to construct the necessary trunk sewers and a joint treatment plant. As a direct consequence of the Citizens' Committee work, three of the municipalities have formed a joint sewerage authority. They are negotiating a contract with consulting engineers Sheppard T. Powell, Whitman, Requardt & Associates and Thomas F. Bowe Associates of New York, N.Y., for the design of a Somerset County project. The two large industries have committed themselves to participate in this project or to construct adequate treatment works of their own. Obviously, the Somerset project is considerably behind the Middlesex project at this time. It is, however, not nearly so complicated. There is every indication that both sewerage authorities are moving forward at a satisfactory pace.

What of the future in the lower Raritan Valley? If these two projects are executed, the Raritan River should be restored as an asset to the valley, instead of an open sewer—an oscillating septic tank—as it is at present.

The patience of many has been strained, but all will be forgotten in years to come if the present indicated progress materializes. Raritan River pollution abatement is a good example of the development of such projects in this country. It has consumed the combined efforts of civic leaders, public opinion generally, and official agencies with legal powers to expedite a positive program designed for the benefit of all concerned, not the least of whom are ivied Rutgers and her stalwart sons.

(This article has been prepared from the paper presented by Mr. Shaw at the ASCE Atlantic City Convention, before the Sanitary Engineering Division session presided over by A. J. Fischer, a member of the Division's Programs and Publications Committee.)

The Middlesex County program materializes

E. SHERMAN CHASE, M. ASCE, Partner, Metcalf and Eddy, Boston, Mass.

In July 1950, the Middlesex County Board of Chosen Freeholders, of New Jersey's Middlesex County, created the Middlesex County Sewerage Authority, with powers to abate pollution of the Raritan River originating in the county. Later state legislation gave the Authority the right to extend its activities beyond the limits of the county to provide for conditions originating in Union and Somerset Counties. Participants in the present program are limited to those listed in Table I.

The population of Middlesex county more than tripled between 1900 and 1950, the census figures being 79,762 and 264,659, respectively. The present (1953) population expected to be served under the service contract is about 187,000. In planning for the future, it is estimated that this tributary population will reach about 360,000 in the year 2000.

Features of project

The project, now in the design stage, involves a main trunk sewer starting at the Borough of Bound Brook. This sewer will parallel, and be north of, the river between Bound Brook and Highland Park. The general features of the project and the location of important municipalities and other geographic features are shown in Fig. 1. In the stretch of river between Bound Brook and Highland Park, connections will be made by the Plainfield Joint Meeting and other participants. Opposite the city of New Brunswick, the sewer will cross from the north to the south bank and continue parallel to the river, to the Sayreville Pumping Station located near the junction of the Washington Canal with the Raritan River.

A major branch trunk sewer (the South River Interceptor) will start in the valley of the South River about 4 miles south of the pumping station and will parallel that tributary to the station. This interceptor will serve the boroughs of South River and Sayreville and the industrial plants of Peter J. Schweitzer, Inc. (paper), Anheuser-Busch, Inc. (yeast), and the Hercules Powder Co. (cellulose products and chlorinated rubber). From the pumping station, a force main will extend in a northeasterly direction to an area bordering the Raritan River near the westerly boundary of South Amboy. At this point, a treatment plant will be constructed from which an outfall will extend to the shores of Raritan Bay in

TABLE I. Contributors to Trunk Sewer Project of Middlesex County Sewerage Authority

	Estimated Flows, 1953, mgd
Municipalities:	
Middlesex Borough	0.98
Plainfield Joint Meeting (Dunellen, Plainfield, North Plainfield)	6.40
New Brunswick (city)	9.40
North Brunswick Township	0.50
Highland Park Borough	0.91
Raritan Township	1.84
Metuchen Borough	1.20
South River Borough	1.15
Sayreville Borough	0.75
Bound Brook Borough	0.80
South Bound Brook Borough	0.30
Total municipal sewage	24.23
Industries:	
Union Carbide & Carbon Corp.	0.13
Anheuser-Busch, Inc.	1.20
Peter J. Schweitzer, Inc.	4.00
Benzol Products Co.	0.30
Heyden Chemical Corp.	0.30
National Lead Co.	1.33
Hercules Powder Co.	2.40
Total industrial wastes	9.66
Total sewage and industrial wastes	33.89

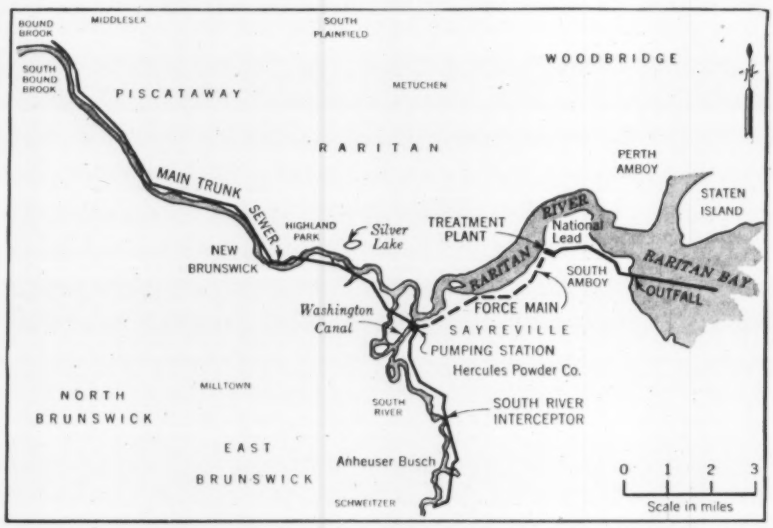


FIG. 1. Proposed plan for sewerage works along tidal stretch of Raritan River marks beginning of the end of New Jersey's oscillating septic tank. Pollution problem was recognized as early as 1909 but rapid industrial and population growth and regional recalcitrance have kept pollution ahead of programs to overcome it.

South Amboy, and thence about 2 miles into the Bay.

The Main Trunk Sewer, approximately 12 miles long, will be of reinforced concrete, approximately 4 ft in diameter at the upper end, increasing to 7 or 8 ft at the pumping station. This sewer is being designed for a peak capacity of 80 mgd at its lower end.

The South River Interceptor, some 3½ miles in length, will be about 24 in. in diameter at the upper end, and will increase to about 54 in. at the entrance to the Sayreville Pumping Station. This sewer will have a peak capacity of 33 mgd at the lower end.

The pumping station will have sufficient capacity to pump the combined peak flows from the Main Trunk Sewer and the South River Interceptor. As at present planned, the station will be equipped with mechanically cleaned bar racks, the screenings to be ground and returned to the sewage. At the moment, it is planned to utilize two separate sources of utility power, and consideration is being given to standby internal combustion engines for emergency use. The static pumping head will approximate 50 ft.

The force main from the pumping station to the treatment plant will be of reinforced concrete 7 ft in diameter and about 3½ miles long. The pipe will be designed for a 100-ft head.

The treatment plant, designed for an average flow of 52 mgd in 1975, will consist essentially of grit removal equipment, chemical feed facilities, mechanical flocculators, sedimentation tanks, and equipment for both pre- and post-chlorination. At this writing, a final decision has not been reached as to sludge disposal methods, pending the results of investigations into the probable character and quantity of the sludge likely to be produced with and without several types of coagulation and precepitation chemicals. In any event, the fact that precipitation of the combined sewage and industrial wastes cannot be depended upon to produce a sludge susceptible to biological action, precludes the adoption of digestion procedures for reducing the quantity of sludge or for rendering it less offensive. Consequently, it is planned to barge the sludge to sea after concentration, either by gravity separation of supernatant in settling tanks, or by mechanical filtration of the wet sludge to reduce its volume and thus lower the cost of barging. It is, of course, possible that incineration may be found more economical and practicable. This is a matter now held in abeyance.

It is proposed to adopt circular combined flocculation and sedimentation tanks arranged in the form of a polygon around a central distribution structure. Chemicals will be brought to the site over a branch railroad leading to the adjacent industrial plant of the National Lead Company. If the sludge is barged to sea, concentration tanks or mechanical filters will be provided and the concentrated sludge will be loaded on sludge barges at a new dock to be built at the bulkhead line on the Raritan River.

After clarification, the effluent will be discharged through an 84-in. reinforced concrete pipe, designed for 117 mgd, extending about 2 miles on land to the shore of Raritan Bay, and thence to a point about 2 miles from shore. The outer portion of the pipe will terminate in multiple outlets. In view of the relatively shallow depth of the bay, the bottom at the location of the outlets will be dredged to provide approximately 30 ft of water over the outlets at low tide.

Results of treatment

It is expected that the treatment works will reduce the sludge-forming settleable solids at least 95 percent; the total suspended solids at least 60 percent; the oxidizable matter about 35 percent; and, with chlorination, the bacterial content over 95 percent. Diversion of the pollution now reaching the lower river, and the provision of more complete treatment of the sewage and wastes originating upstream in Somerset County, will permit the river to recover sufficiently to restore its recreational value.

As regards Raritan Bay, numerous studies of tidal currents and of the physical and chemical characteristics of its waters indicate very clearly that the degree of treatment proposed will produce an effluent readily and rapidly assimilated. Because of its shallowness, the bay is capable of rapid reaeration, and the tidal currents are such that the effluent discharged at the point selected will move in a generally mid-bay course and away from the shores. Cleaning up of the river will eliminate the pollution it now brings into the bay and will consequently result in improved conditions along the shore at Perth Amboy and South Amboy.

The construction cost of the entire project, including contingencies and engineering, as estimated in 1952, is approximately $20,000,000. Revised estimates will be made on completion of the designs. Other costs, including administration, reserves, interest during construction, purchase of existing facilities, land, and rights-of-way, are expected to add about $3,000,000. Annual operating and fixed charges during the first years of operation have been estimated to approximate a million dollars. Obviously, accurate costs cannot be established until actual operating experience has been obtained, this being particularly true where chemical treatment is involved.

The project will be financed by revenue bonds. Advance funds for the engineering designs have been obtained by a loan secured by the pledges of the credit of the participating municipalities and industries. The respective amounts pledged have been based on a schedule of charges set up in the formal agreement between the Authority and the participants. The schedule of charges is based on the quantity and quality of the sewage and wastes estimated to be contributed by each.

Detailed engineering design is being carried out by four engineering organizations, as follows:

Main trunk sewer	Charles J. Kupper
South River Interceptor / Sayreville Pumping Station	Bogert-Childs Engineering Associates
Sayreville force main	Elson T. Killam
Central treatment plant and outfall	Metcalf & Eddy

In addition, Metcalf & Eddy acts as an overall consulting, reviewing, and coordinating agency for the various divisions of the design. Messrs. Abel Wolman, M. ASCE, and Floyd Mohlman, together with the writer, constitute a consulting board to review the broad engineering principles involved and the general methods adopted for the solution of the pollution problem.

The Middlesex County Sewerage Authority has broad legal powers to direct, construct, finance, and operate the project. The Authority is composed of members appointed by the freeholders of the counties involved, as follows: Chester A. Lydecker, Chairman; Marsh B. Tipton, Vice-Chairman; and Herbert D. Dailey, Charles E. Goudreau, Sol R. Kelsey and Alvan D. Simpson. The counsel is Edward J. Johnson and the secretary-treasurer, Edward F. Dunlap. During the initial stages, George Smith of Johnson & Johnson was the Authority's chairman, and to his tremendous energy and skill in promoting the project is due much credit for its ultimate success. He was ably assisted by W. H. Baumer and Mat Adams, loaned to the Authority by Johnson & Johnson. Mr. Smith is now honorary chairman of the Authority.

The designs are expected to be completed in the spring of 1955, and the project must be under construction before the end of that year.

(This article has been prepared from the paper presented by Mr. Chase at the ASCE Atlantic City Convention, before the Sanitary Engineering Division Session presided over by A. J. Fischer, a member of the Division's Program and Publications Committee.)

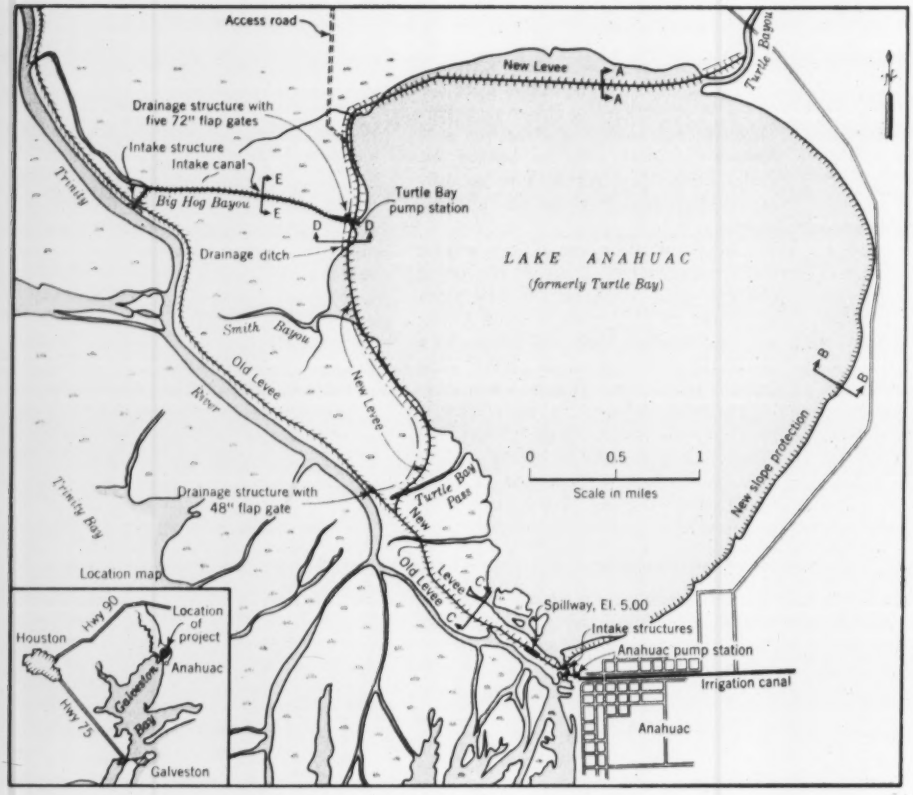
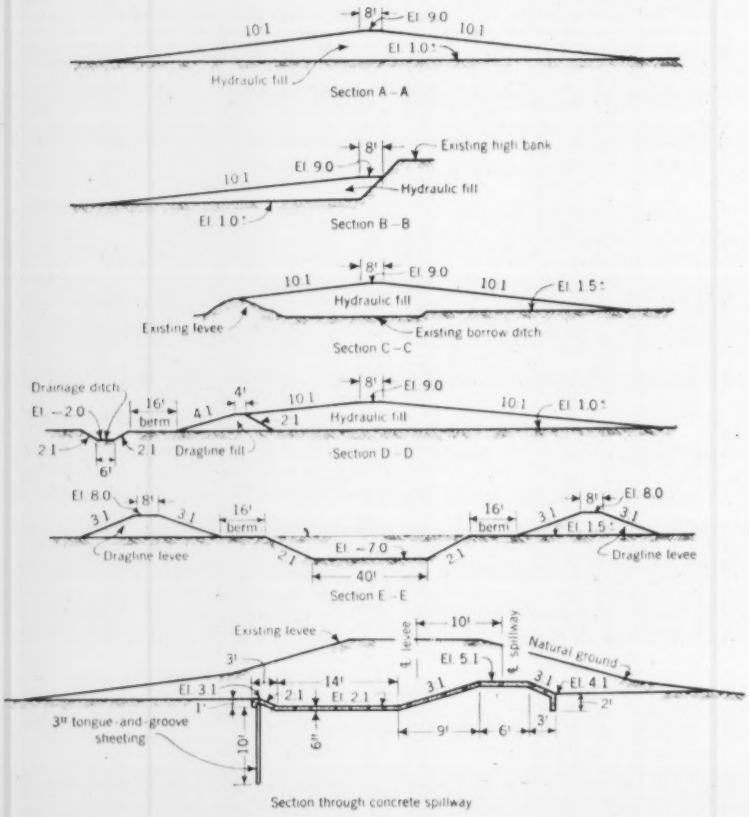


FIG. 1. Turtle Bay, near Galveston, Tex., on Gulf of Mexico, will form reservoir for irrigation water with capacity of 35,000 acre-ft. Principal construction on this project consists of encircling levees, two pumping stations, spillway for flood relief, and incidental drainage structures. New Turtle Bay Pumping Station pumps water into storage from Trinity River; existing Anahuac Pumping Station, as enlarged and renovated, pumps water into irrigation canal, either from Turtle Bay or from Trinity River. Map at left shows location of cross sections below.



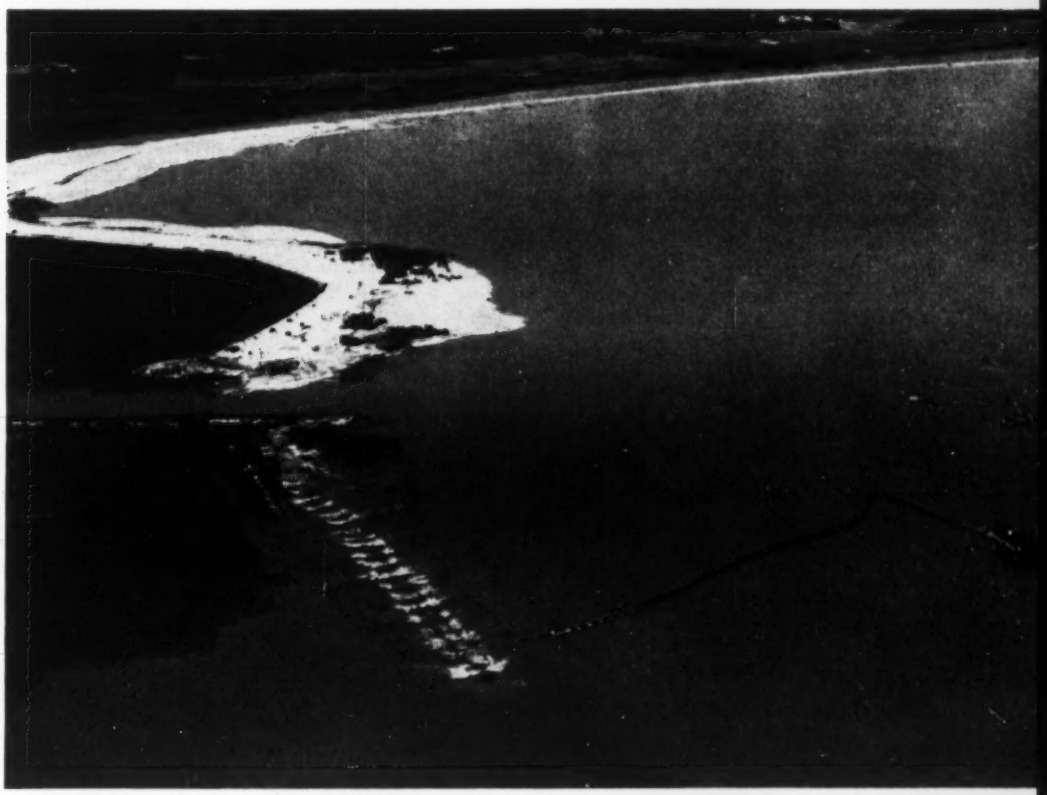
C. A. WEISE

Project Engineer, Freese, Nichols & Turner
Consulting Engineers, Houston, Tex.

The Turtle Bay project is one of the first major attempts to convert a natural bay or inlet along the Gulf Coast into a reservoir for fresh-water storage. Since such natural bays are numerous along the Texas coast, this may well be the forerunner of many such projects to provide water for rice irrigation and industrial uses.

Turtle Bay, to be known as Lake Anahuac in the future, is just north of Anahuac, in Chambers County, Texas. It covers an area of about 5,200 acres and, before the recent construction, averaged 2 ft in depth below sea level. Once a part of Trinity Bay (northern arm of Galveston Bay), which contains tidal water, it was isolated by natural extension of the Trinity River Delta.

Years ago an earth levee was constructed across the marshland of the river delta on the south and west sides of the bay, and connected to high ground at both ends, to exclude salt water. This provided approximately 17,000 acre-ft of storage for rice irrigation, the water being obtained en-



Looking north across intake canal (Big Hog Bayou) on western side of Turtle Bay, completed levee is seen at upper left and levee base under construction by cutterhead dredge in foreground. On far side of intake canal, on levee center-line, foundation piling is in place for Turtle Bay Pumping Station. Just to left is drainage structure with five automatic gates.

Gulf Coast inlet converted to fresh-water reservoir

tirely through runoff from the Turtle Bayou watershed of approximately 130 sq miles. Through the use of two sets of timber gates at the forebay of the irrigation pump station (Anahuac Station) at the southernmost tip of the bay, irrigation water could be pumped from the Trinity River as well as from storage in the bay (Fig. 1).

Financing by Navigation District

Financing of the improvements on the storage and pumping facilities presented a unique problem to the Chambers-Liberty Counties Navigation District, which owns and operates the irrigation system. The cost is being paid for entirely through revenue bonds. To secure sufficient funds for the improvements as well as to clear a $300,000 indebtedness remaining from the original purchase of water rights, canal system, pumping station, and other assets, a bond issue of $1,250,000 was authorized by the Navigation District.

A syndicate headed by Eddleman-Pollock Company of Houston purchased the bonds at an average interest rate of 4.33 percent. These bonds are secured by a closed mortgage on all the physical properties of the system, water rights, intangibles, and other assets, and are payable solely from net revenues. No tax can ever be levied to pay principal or interest on these bonds. Except for minor industrial users, some 125 rice farmers are at present providing the revenue for payment of the bonds.

Through this system, 21,000 acres of rice are being irrigated each year. It is planned to increase this acreage to 25,000, and an increase in industrial use is also anticipated. With this additional demand, a firm supply of 75,000 acre-ft per season is necessary. This amount has been assured with the improved reservoir capacity of 35,000 acre-ft.

Water is placed in storage by a new pump station, the Turtle Bay Station, through a canal connecting with the Trinity River at a point about 4.5 miles above its mouth (Fig. 1), during periods of adequate river flow. This is in addition to the runoff from Turtle Bayou. The Turtle Bay Pump Station was constructed to house three pumps, each of 67,000 gpm capacity, with two installed initially. The maximum lift is 6 ft.

The old pump station at the southernmost tip of Turtle Bay, the Anahuac Station, was rebuilt and enlarged to a capacity of 240,000 gpm, obtained by two new pumps of 80,000 gpm each, together with two old and smaller pumps The maximum lift at this station is 25 ft. As in the past, this station will be used to pump the water into the irrigation canal, either from the Trinity River or from storage in Lake Anahuac.

At the Anahuac Station, the old timber gates have been replaced by two reinforced concrete intake structures to permit pumping from either the Trinity River or Turtle Bay into the irrigation canal. Each intake structure contains four cast-iron sluice gates 72 in. square.

A similar intake structure on the intake canal between the Trinity River and the Turtle Bay Pump Station

facilitates the draining of a large area of low ground north of the bay. The area is drained into the intake canal through a set of five 72-in. asbestos-bonded, corrugated, galvanized metal pipes with automatic drainage gates. When the water level in the river is very high, the sluice gates can be totally or partially closed while pumping, thus enabling the pumps to readily drain the area.

Levee construction

The storage level in the bay has been raised 3.5 ft to El. 5.10 mean sea level. To provide this level, new levees had to be built and old ones raised. On the south side of the bay, parts of the old levee were raised and the slopes flattened. On the west and north sides a new levee with flat side-slopes was constructed. On the east side, the existing bluff had suffered serious erosion, and therefore a flat, sloped fill was placed against the bluff. See Fig. 1 (b). The minimum elevation of the levees and sloped fills is 9.00 ft, providing a freeboard of 4 ft, less shrinkage and settlement. Inside slopes were constructed on 10:1 to prevent erosion by wave action. Slopes will be seeded with Bermuda grass. Considerable lengths of the new fill are protected by willows and cane, and it is proposed to plant willows in unprotected areas subject to severe wave action.

Levees and sloped fills were placed by pipeline dredge. The soils on the east and south sides of the bay are predominantly clay, while those on the north and west sides consist of a silty, very fine sand. Large quantities of clamshells were found on the north and west sides, and aided in securing a good, stable fill. Tests indicate that seepage losses through the levee under the proposed 5-ft hydrostatic head will be negligible.

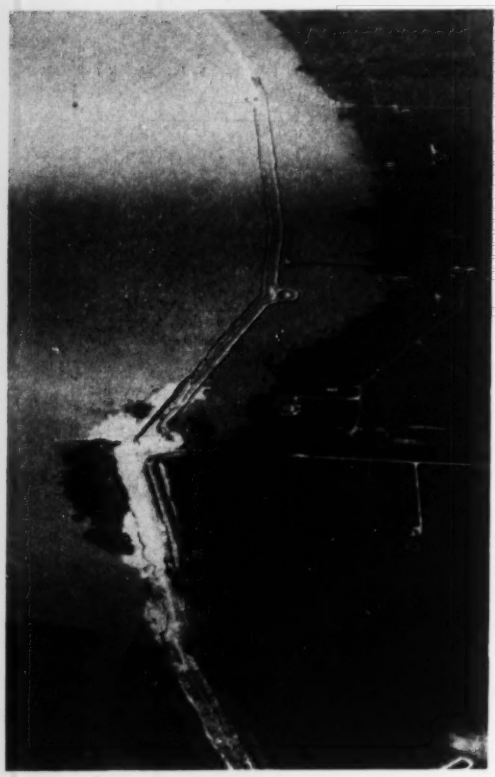
The only practical method of constructing the levees was by hydraulic means since the borrow area of necessity had to be limited to a minimum distance of 750 ft from the center line of the levee. About 1,300,000 cu yd of hydraulic fill was placed.

Where the borrow material consisted of clay, no particular difficulty was encountered. The silty, fine sand, however, has a very flat natural slope. For this material, retaining dikes were found necessary. These dikes were constructed by draglines, working on the natural ground level where it was high enough. On some sections, where the natural ground was too far below the water surface, a low fill, or levee base, just above the water-surface elevation, was pumped in by dredge to provide a base on which the draglines could work. Hydraulic fill was then pumped in between the dikes and graded to the proper slopes. Hydraulic fill was measured in place for payment after the final grading, and after the fill had reached a satisfactory stability. Very little subsequent settlement or shrinkage has been noted.

A concrete-slab spillway 700 ft wide, with its crest at El. 5.10, will accommodate heavy floods originating on Turtle Bayou. A plug section in the levee itself, with a finished grade one foot below the normal levee grade, will provide emergency relief in the event of an extreme flood.

The total cost of the improvements, including construction, engineering, legal, and right-of-way costs, was $900,000. The project is substantially complete and functioned during this past irrigation season as intended.

Designing and consulting engineers for the project are Freese, Nichols & Turner of Houston, Tex. Brown & Root, Inc., of Houston, has the contract for the storage and drainage facilities and the Tellepsen Construction Co., also of Houston, constructed the two pump stations.



Silty, fine sand encountered on north and west sides of Turtle Bay presented difficulty in hydraulic levee building because of its flat natural slope. Therefore retaining dikes were built by dragline operating on low hydraulic fill, as seen in this view looking west across north end of bay, with Turtle Bayou in foreground. Later, more hydraulic fill was pumped in between dikes and sloped, as seen in completed levee in foreground.

Anahuac Pumping Station has two intake structures (below). North intake, in foreground, takes water from Lake Anahuac through four cast-iron sluice gates, each 72 in. square, with two-gear-ratio lifts. South intake, under construction in background, takes water from Trinity River through similar gate arrangement.

Low-cost pavement stretches the maintenance dollar

W. E. KENNEDY, Director of Public Works, and **W. E. PEEBLES,** J. M. ASCE, Assistant Director of Public Works, City of Inglewood, Calif.

The City of Inglewood, Calif., has recently constructed a new type of low-cost pavement resurfacing with many interesting features. It is important to recognize that this method of resurfacing is only as sound structurally as the base of the existing pavement. Should there be local base failures, they will have to be removed and the base condition corrected. Raveling, cracking, disintegration, or surface failures can however be neglected, as this method corrects this type of failure at the time of application.

The street or highway should be free of weeds such as are found in the cracks of many city streets and along gutter lines. The weeds are removed, either by hand or blade, a few days before resurfacing and a weed killer applied. The edge of the pavement is usually bladed ½ in. deep to obtain a better bond next to the concrete gutter. This operation is optional depending on the original type of pavement and its condition at the gutter line. A three- or four-man crew can complete an average block with an excessive weed condition in one day. Usually preparation can be accomplished at the rate of three blocks a day.

Resurfacing is done in four continuous operations, depending on traffic conditions, at the rate of 60,000 to 80,000 sq ft per day. The first operation consists of burning the street with a pavement burner at approximately 2,200 deg F, and pulling a modified pavement scarifier behind the burner. The burner softens the existing pavement, and the drag scarifies and levels at the same time.

The drag, approximately 9 ft wide, consists of a series of bars with 20-penny spikes spaced 2 in. on centers. The type of pavement determines the depth of penetration of the spikes, which in nearly all cases has been ½ in. It should be remembered that complete scarifying of the existing pavement will not be possible as low spots will be missed. It is our belief that the burning operation revitalizes the existing pavement oil so that, while the scarifying provides an excellent bond, the same bond is obtained at the low spots.

Following the burner-scarifier, while the existing pavement is still warm, a tack coat of SS-2 (Asphalt Institute Specifications) is applied at the rate of 0.10 gal per sq yd.

Immediately following this operation comes the pavement layer, Barber-Greene, adjusted to place approximately 10 lb per sq ft, or a 1-in. thickness. At the proper rolling temperature, the pavement is rolled and the project completed.

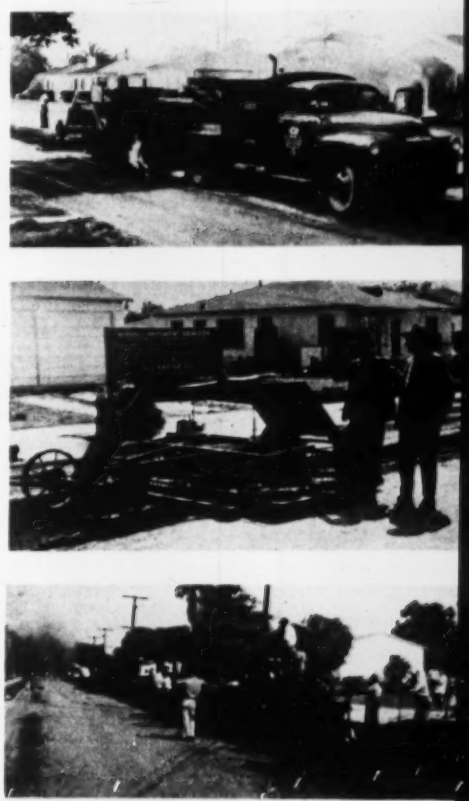
The pavement specifications call for a ¾-in. maximum aggregate with 5 to 7 percent of the following: 80–100, 150–200 paving asphalt or SC-6 oil, the latter being used on secondary streets and the former on major streets, or streets with a high traffic volume.

Specifications for the aggregate grading are:

Size	Percentage Passing
¾ in.	100
½ in.	95–100
No. 4	50–60
No. 8	40–50
No. 30	25–35
No. 100	12–20
No. 200	6–10

This paving operation has many advantages, among them being low cost; ease of preparation (in that an average block can be completed, after weed control, in one day, with the street open for traffic that evening); excellent bond to the existing pavement; and an excellent, water-repellent surface provided by the dense mix.

The work, which includes burning, scarifying, and pavement material in place, is let by a yearly contract on a square foot basis at a cost to the City of Inglewood of 4½ cents per sq ft. Our forces raise the manholes after the project is completed.



Resurfacing is done in four continuous operations. First, pavement burner (top) pulls scarifier (middle). Tack coat of SS-2 asphalt is added while pavement is still warm, immediately followed by Barber-Greene pavement layer (directly above).

ENGINEERS' NOTEBOOK

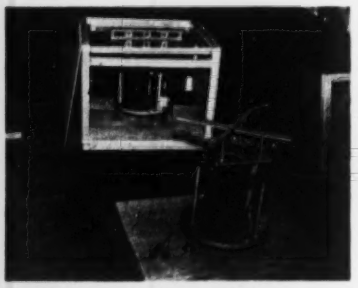
Recording evaporation gage provides year-round record

W. J. ROBERTS, A.M. ASCE

Associate Engineer,

State Water Survey Division, Urbana, Ill.

There is need of a better instrument for measuring evaporation from a water surface, especially one that can record water loss the year round. An instrument to meet this need has been designed and built in the hydraulic laboratory of the Illinois State Water Survey. A rain gage of the standard weighing-bucket type was modified so that the 8-in. collector ring was replaced by a square pan 2 in. deep with an area 10 times that of the collector ring. An overflow pipe, built into the pan, prevents flooding of the instrument.



Two automatic rain-gage mechanisms are seen being assembled. That in foreground has angle-iron X-frame attached to normal bucket seat. That in background has square aluminum pan resting on X-frame, and is partly enclosed in cabinet housing.

A review of the literature indicates that four ways of measuring evaporation from bodies of water have been used. (See Interim Report, Lake Mead Water Loss Investigations, a review of evaporation theory and development of instrumentation. U.S Navy Electronics Laboratory, San Diego, Calif., 1950.) One is the water budget method, which involves measurement of runoff, change of storage, and spillage. Generally with this method, errors in measurement, plus seepage in and out of the storage basin, could be greater than the actual evaporation. A second method is based on the energy available for evaporation, and the third depends on the measurement of certain factors affecting water-vapor transport. The second and third methods take into account recent extensions of meteorological theory and have been tested extensively in the Lake Hefner water-loss study. (See *Water-Loss Investigations*, Vol. 1: Lake Hefner Studies, Technical Report, U.S. Geological Survey Circular 229, 1952.)

The fourth method measures evaporation from pans of various sizes and shapes. The standard instrument for this is the U.S. Weather Bureau Class A evaporation pan, which has a diameter of 48 in., a depth of 12 in., and is filled with water to a depth of 10 in. Water levels in the pan are measured in a stilling basin with a hook gage. Observations are generally made once daily, and the records therefore give only the total evaporation during the period between measurements. Pan evaporation records are made during the frost-free season and, in higher latitudes, are generally discontinued in winter because of low temperatures. This seasonal gap in records prevents accurate determination of pan-to-lake coefficients. For this reason an instrumental record of winter evaporation would be of practical value. The desirability of a continuous record of evaporation rates, for a better understanding of the phenomenon, is evident.

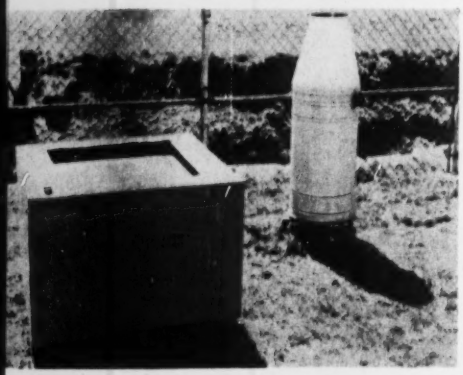
The new automatic recording evaporation gage employs a pan to measure evaporation in a procedure which is the reverse of the normal method of measuring rainfall. With water in the pan up to the level of the overflow, the pen is positioned at the top of the regular chart. As water is lost through evaporation, the pan becomes lighter and the pen drops on the chart. The chart is attached to a drum which is driven by a clock mechanism. The gear arrangements permit one revolution of the drum in either a week or 48 hours.

Except for normal cleaning of the pan, the instrument requires little more attention than an 8-day automatic rain gage. During periods of dry weather, water will have to be added to the pan every day to maintain the level at the overflow.

The instrument has the advantage of producing a chart record on which the rate of evaporation as well as the total amount over a period can be measured. Perhaps the most important advantage of this instrument over the Class A type Weather Bureau gage is that it will record evaporation or sublimation from an ice surface in the wintertime.

Three of these automatic instruments have been installed in northern, central and southern Illinois. They have been operated from February 1953 to the present. Each instrument is installed adjacent to a Class A type evaporation pan. The studies in progress include effects of water depth, solar radiation, temperature, wind, and other factors on the representativeness of the observed values. Although it is hoped to arrive at suitable correlations between the recorder-type instrument and the pans, it is realized that this recording instrument will have its greatest use in winter months of subfreezing temperatures when regular pan operations cannot be conducted.

First model of evaporation gage (evaporimeter) is seen, at left below, in Urbana installation. For servicing, front side of housing is lifted from supporting pins. On two later models, hinged door was substituted. Standard weighing-bucket rain gage, at right, records precipitation.



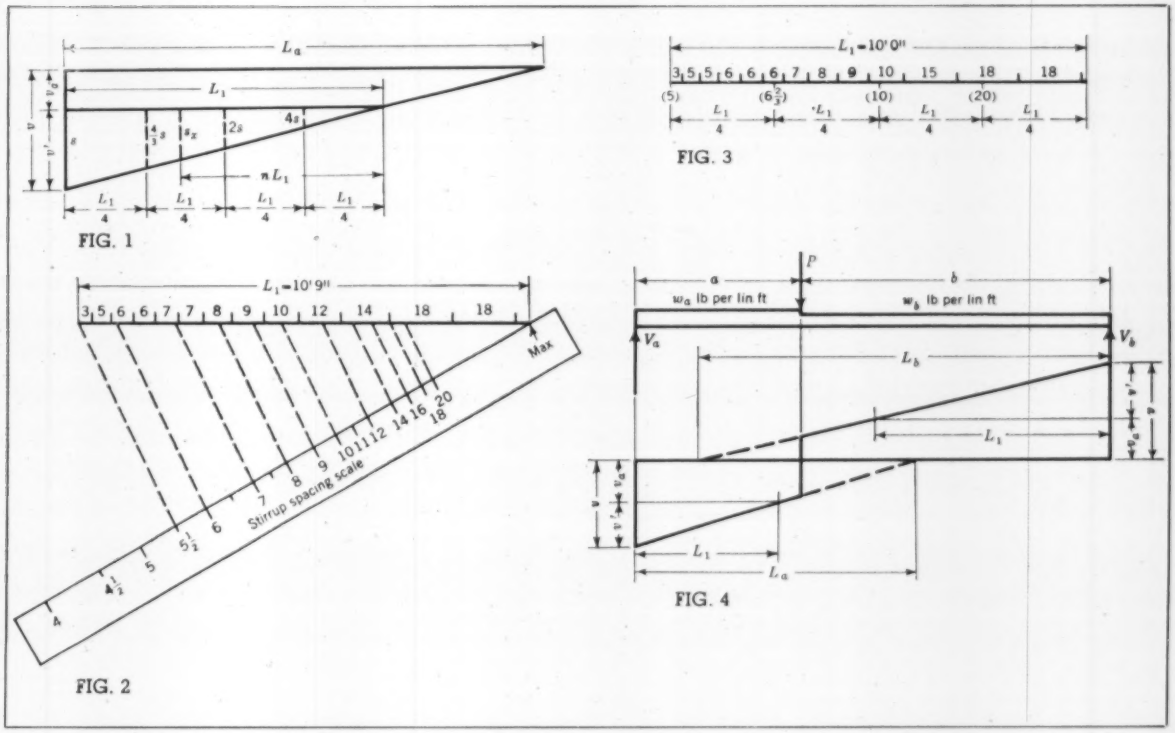


FIG. 1

FIG. 3

FIG. 2

FIG. 4

Stirrups spaced by simple methods

SVEN G. ROEBLAD, M. ASCE

Chief Engineer, Aberthaw Company
Boston, Mass.

Since there seems to be a perennial interest in stirrup spacing, I am emboldened to present my own methods here. It is usually unnecessary and cumbersome to first determine the total number of stirrups required and then find the spacing to fit the number. It is simpler to compute the required spacing at various points of the beam and space the stirrups accordingly.

If we have a triangular shear diagram of length L_1, a required spacing of s at the maximum shear end, the spacing at a point nL_1 from the zero end will be $s_x = s/n$. From this it follows that the spacing at $^1/_4L_1$, $^1/_2L_1$, and $^3/_4L_1$, will be $4s$, $2s$, and $^4/_3s$ (Fig. 1). If the beam is uniformly loaded,

$$L_a = \frac{L}{2}, \text{ and } L_1 = \frac{L}{2}\cdot\frac{v^1}{v},$$

where $v^1 = v - v_a$ and v_a is the amount of shear to be taken by the concrete.

As an example, if $s = 5$ and $L_1 = 10$ ft 0 in., and we lay out L_1 to scale, establish the quarter points and spot the required spacing at these points, the remaining spaces can be filled in by interpolation (Fig. 2). The first stirrup is placed a distance of $s/2$ or a minimum of 3 in. from the support and the maximum spacing is assumed to be 18 in. This method is simple and will be sufficiently accurate in most cases. In the June 1954 issue of CIVIL ENGINEERING, Allen H. Brownfield makes reference to this method in a letter to the editor (page 70).

A somewhat more elaborate method is to construct a stirrup-spacing scale which can, for instance, be scratched into the side of a triangle. In constructing the scale, assume L_1 to be any convenient length, start with s having what might be considered a minimum practical value, say 4 in., and compute all intermediate values. The distance from the maximum spacing mark to a spacing of s_x will be $\frac{s}{s_x}\cdot L_1$ (Fig. 3).

To use the scale, place the maximum spacing mark of the scale at the zero end of the shear diagram, connect the computed spacing value at the support on the scale with a straight line to the maximum shear end of the diagram and project the intermediate spacing values unto the distance L_1 by parallel lines. The stirrup spacing can then be written in along L_1 with the projection lines as a guide.

The above methods can be extended to cover irregular or concentrated loading, an example of which is shown in Fig. 4. Find $L_a = \frac{V_a}{w_a}$ and $L_1 = \frac{v^1}{v}\,L_a$ and proceed as before. Space stirrups over distance a. Proceed similarly over distance b.

THE READERS WRITE

ASCE action on competitive bidding approved

TO THE EDITOR: Permit me to express my hearty approval of the forthright action taken by ASCE in the matter of competitive bidding for professional services. Without passing judgment on those individuals against whom the action was taken, may I say that it is the issue itself that is the matter of importance.

We have long sung into the wind about our professional "rights" and long bemoaned the lack of public recognition of those "rights." We have not often enough been willing to accept the responsibility that necessarily accompanies the privileges of professional status.

Bidding for professional services is not only historically improper but, in actual practice, invariably results in a lower standard of practice, with resulting damage to profession and client.

ASCE is to be congratulated for helping engineering earn its right to call itself "professional."

S. A. BAUER, A.M. ASCE
Bauer Surveys Company
Civil Engineers and Surveyors
Cleveland, Ohio

Crossing muskeg then and now

TO THE EDITOR: In CIVIL ENGINEERING for August (p. 88) I was interested in the item describing modern equipment for crossing muskeg bogs. This is in marked contrast to the method we employed in northern Canada, more specifically, near Meadow Lake, Saskatchewan, when I was there on a survey in 1912. I enclose two photographs taken at that time.

Everything was unloaded from the wagons and carried across by the men. The horses were led across and the wagons were hauled across by hand. It required a full day for us to cross one muskeg bog three-quarters of a mile wide. We had two heavily loaded wagons, a single-seated buckboard, and five horses.

A. T. CUSHING, M. ASCE
Cushing & Cushing
Consulting Engineers
Kansas City, Mo.

Two photographs taken in 1912 show Mr. Cushing's party crossing muskeg in northern Canada. All loads had to be carried across by men on foot.

All-track vehicle designed for crossing muskeg carries 2,500-lb load in addition to its own weight (from *Civil Engineering*, August 1954, page 88).

Sea-level project recommended for Panama Canal

TO THE EDITOR: With reference to the article on "The Panama Canal Problem," in the July issue, page 58, I would like to bring out some of the reasons favoring the sea-level canal:

1. The majority, that is eight, of the members of the board of American and foreign consulting engineers appointed by Congress in 1905 to advise President Theodore Roosevelt, recommended that the canal be made sea level. It was not constructed at sea level then because of the need to complete it in the shortest possible time.

2. The seven-man Board of Consulting Engineers appointed by the Governor of the Panama Canal, Public Law 280, and approved by President Truman, working with Col. J. H. Stratton (now Brigadier General retired) and his staff in 1945 to 1947, also recommended a sea-level canal. This was brought out in the symposium on the Sea Level Project for the Panama Canal (TRANSACTIONS of ASCE, Vol. 114, 1949). These recommendations, made in 1905 and again in 1947 by the world's outstanding engineers in collaboration with the Corps of Engineers, U. S. Army, were also concurred in by the Navy General Board, the Joint Chiefs of Staff, and the Atomic Energy Commission. They are recorded in voluminous papers and publications for all to read and evaluate.

3. The 1947 report should eliminate arguments for a sea-level canal at any other location because of the excessive construction costs. Also, to replace the fortifications and extensive harbors at the present canal location would, according to Colonel Stratton, cost over $1 billion.

4. Pilots of the Panama, Suez, Cape Cod and Houston Ship Channels, who should be the best judges of navigating the canal, together with other leading authorities, all agree that the proposed 60-ft-deep by 600-ft-wide sea-level Panama Canal is satisfactory for two-direction traffic of large commercial vessels in currents up to 4.5 knots. The exception might be for low-powered vessels, for which tugs could be available to render assistance. Thus the costly tidal locks and their maintenance could well be eliminated, with their possible obstruction of the canal as a result of enemy bombing.

5. A major slide caused by enemy attack could be removed from the sea-level canal in a couple of months by a large dredging plant, whereas blowing up the locks would drain Gatun Lake and require years to repair, provided atomic radiation permitted. Furthermore, almost any type of bomb could damage the locks, while only the most massive bombing could damage the canal. Also with Gatun Lake once drained, it would be much more costly to construct a sea-level canal, and in the meantime shipping would have to go around South America.

On page 855 of the ASCE PROCEEDINGS for April 1948, this writer submitted a short discussion on the advantages of using large hydraulic dredges and booster plants for excavating the sea-level canal.

These would reduce dump-scow and truck hauling to a minimum or eliminate it altogether. As stated, the material could be dumped directly into the levee and dam sections and/or into the spoil areas in Gatun Lake. Consideration should also be given to the better levee and dam construction that can be obtained by the hydraulic-fill method.

In my discussion in the ASCE PROCEEDINGS, I recommended hydraulic dredges with a 60-in. discharge for the construction of the sea-level canal, and stated that two such dredges with booster plants could handle about 70,000,000 cu yd of material per year. On this basis, three dredges could probably complete the excavation in nine years. All the soft material and medium hard rock could be excavated without blasting. The high banks could be brought down to dredge cutter and suction by blasting. The hard rock could be drilled and shot as required for good pumping. The 60-in.-hydraulic dredge pumps would pass 40-in. solids, and cutters would screen out larger rocks.

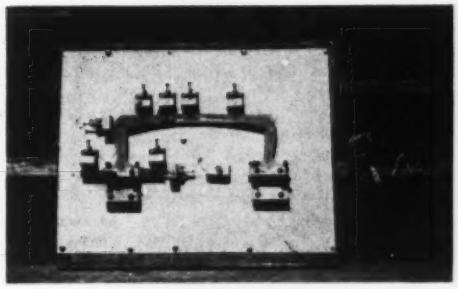
The 60-in. dredges would require 25,000 to 30,000 hp on dredge pump and on each booster, and 5,000 hp on cutters. The dredge hulls would be approximately 60 by 300 ft long by 18 to 20 ft deep. The dredge ladder for 145-ft-deep dredging would have one pump and the cutter drive installed on the ladder. The ladder would be partially buoyant and about 210 ft long. Shorter ladders would be used for dredging up to an 80-ft depth. Dredge pumps would be driven by steam turbines and reduction gears and/or by diesel engines and reduction gears.

Some will say that such dredges cannot be built and operated successfully. However 36-in. dredges are operating at present and two more 36-in. are being built for a dredging job in Canada of over 175,000,000 cu yd. This job requires a vertical lift of up to 500 ft and over 30,000 ft of discharge pipeline. These dredges now are under construction and will have 10,000 hp on the dredge pump and 2,000 hp on the cutter. Each dredge will also have two boosters of 10,000 hp. For this job one 48-in. dredge was considered, but for flexibility of operation it was decided to use two 36-in. dredges instead.

A production of 100,000 cu yd per day in soft materials, and pipeline pressures up to 180 lb are not unusual now. Dredging soft to medium hard limestone and coral rock without blasting is now also common. I recall that twenty years ago 3,000 hp on the pump, and 750 hp on the cutter, were considered high, and little rock dredging was done without blasting.

Reconsideration of the sea-level canal excavation by the use of 60-in. or larger hydraulic dredging plant will tremendously speed construction time, and reduce cost. A combine of large earth-moving and dredging contractors accustomed to large jobs and equipment may well contract to do this job at an estimated cost, based on present-day dredge performance, of 75 cents to $1.00 per cu yd pumped into dams, levees, and/or spoiled into Gatun Lake.

OLE P. ERICKSON, M. ASCE
Tampa, Fla. *Consulting Engineer*



Electric caliper, as developed by Mr. Cox's father in 1932, includes provision in left-hand reaction for introducing both thrust and moment. Signal light is in center and dry cells at right of drawing board. Snapshot at right shows dial on screw of apparatus built by Mr. Cox himself in 1938.

Model analysis with electric caliper

TO THE EDITOR: Reference is made to the article by John P. Cook, J.M. ASCE, in the August issue, page 66, on a "New Deformeter Developed for Structural Model Analysis."

In 1932 my father, L. W. Cox, M.ASCE, became interested in model analysis. Because of the expense of Beggs equipment, he developed a system using commercially manufactured screws with a cardboard dial subdivided to increase the sensitivity of the reading. Contact between the caliper screw and "feeler" on the model was indicated by a small bulb lighted with dry cells. Reaction of the frame vertically and horizontally was also accomplished by a threaded screw arrangement.

In December 1938, I wrote my senior thesis at Iowa State College on "Model Analysis with Electric Caliper and Micrometer Microscope." In this thesis, I compared the accuracy of a new set of electric calipers which I had built, to a Beggs filiar microscope and to the results of moment distribution. The three methods of analysis were applied to a U-bent frame with satisfactory results.

At the time, the method seemed to promise two advantages over the filiar microscope. Economy permits use of more calipers and more points of measurement. Also I believe that where a dial is used on a caliper, that instrument is more easily and accurately read than a microscope.

FRANCIS W. COX, A.M. ASCE
Omaha, Nebr.

Plastic versus elastic design

TO THE EDITOR: Professor Hoadley is to be commended for his thought-provoking article, "Continuity—Asset or Liability?" in the July 1954 issue. It recognizes the practical need for a common-sense compromise between classical elastic continuous-frame analyses and everyday practice, which, although often very much at variance with these analyses, has been producing structures whose complete adequacy has been demonstrated by a half century or more of service.

Professor Hoadley has chosen for his study the very common situation where horizontal forces are assumed to be negligible or resisted entirely by elements of the structure other than the steel framing. In his third solution, having recognized the existence of end-restraining moment developed by the beam-to-column connections, he has proportioned the columns to take this moment without exceeding presently permitted working stresses.

His estimate of an 18,500 lb-ft moment at the beam connection, based on the test data reported by Prof. J. Charles Rathbun, M. ASCE, is in good agreement with data obtained at Lehigh University several years ago. From these later tests it would appear the pairs of $4 \times 3^1/_2 \times {}^3/_8 \times 11^1/_2$ angles, framing a 38-ft uniformly loaded 21 WF 62 beam between fairly stiff columns, might be required to resist a moment somewhere between 16,000 and 18,500 lb-ft when the beam is stressed in bending to approximately 20 ksi (kips per sq in.), and that the corresponding joint rotation might be in the order of 0.008 to 0.010 radians. However, when the applied moment in the Lehigh test was approximately $1.7 \times 18{,}500$ lb-ft, the corresponding joint rotation was 0.04 radians (more than 2 deg) and the test was stopped, since it was obvious that the maximum resisting moment of which the connection was capable had been reached. It is very doubtful whether angles of the size described by Professor Hoadley would be capable of resisting the 57,000 lb-ft moment he computed from the Rathbun data.

In recent years a good deal of study has been given at Lehigh University to an evaluation of the "ultimate" (as distinct from "elastic") strength of continuous steel frames. Based largely on the work of Prof. J. F. Baker, A.M. ASCE, at Cambridge University, the British have already adopted the newer concept, and several buildings have been constructed in England using the plastic theory of design.

If we multiply Professor Hoadley's 1,140-lb per ft uniform design load by a "load factor" of 1.75, one satisfactory "plastic" design would call for 6 WF 25 columns and an 18 WF 55 beam, having a

total weight of 2,840 lb—only 0.5 percent more than Professor Hoadley's simple beam-and-column design and 8.7 percent lighter than his semi-rigid design (14.8 percent lighter than his rigid-frame bent).

Analyzing this continuous frame for the given 1,140-lb per ft design load, it will be found that all the stresses are well below the yield-point level—in fact only slightly higher than now permitted. The maximum beam moment occurs at midspan, producing a bending stress of 22.0 ksi. The moment at the top of the column produces a bending stress of 18.3 ksi. At the same time the column receives an average (axial) unit stress of 2.9 ksi, which is less than 15 percent of the maximum combined column stress.

If Professor Hoadley's semi-rigid frame were overloaded in the order of 1.75 times the intended design load, assuming a yield-point stress of 33 ksi, the 21 WF 62 beam would approach the limit of its usefulness. The semi-rigid connections would not have been able to develop their full moment-resisting capacity because of excessive rotation. Assuming, however, a full 1.75 × 18,500 lb-ft column moment, and lateral support at the top of the column, the 6 WF 25 columns might conceivably be on the verge of failure; 6 WF 15.5 columns probably would have collapsed.

Within the overload range of 1.0 to 1.5 times the normal design load, the plastically designed frame would behave elastically and would be very much stiffer than its 11-percent heavier semi-rigid counterpart. Furthermore it would be capable of resisting unexpected horizontal forces that would wrack the latter beyond all limits of usefulness.

Even within the overload range of 1.5 to 1.75, when "hinges" may be expected to start forming at the top of the columns in the plastic design, this frame still would be stiffer than the one using standard beam connections. While it was not a condition of the problem that the bents be required to resist horizontal forces, a capacity to do so is not without virtue.

For the relatively small frame in the given example, ordinary framing angles such as the ones assumed, capable of developing a moderate degree of rigidity and upward of 15 percent of the full fixed-end moment of the beam, generally would be considered an entirely satisfactory solution. Most contractors would estimate the fabrication and erection costs somewhat under those which would be involved using suitable rigid-type beam-to-column connections. As the proportions of the frame increase, however, the standard framing connection angles must afford a decreasing amount of rigidity. At some point the greater stiffness and lateral rigidity of a fully-continuous frame is to be preferred, even though no significant horizontal loads are a condition of the design. When this point has been reached, a plastic design would seem more logical than the heavier elastic designs required under present practice.

T. R. Higgins, M. ASCE
Director of Engineering
American Inst. of Steel Construction, Inc.
New York, N.Y.

Further comments on continuity in building frames

To the Editor: The comments of Anthony Hoadley, M. ASCE, on "Continuity—Asset or Liability?" in the July 1954 issue, are interesting to designers of building frames. But to avoid giving an erroneous impression to some readers, they should be extended. Professor Hoadley's analysis is for vertical loads only. Also, the effect of the design of the frames on the design of other parts of the building is not considered.

All building frames must be designed to resist the lateral force of wind and, in some localities, a greater lateral force due to earthquakes. Designing a frame as hinged at its base and also hinged at the top of its columns would make it incapable of resisting any lateral force, and such frames could not be used in an open-end shed. For a building with end walls, the roof could be designed to prevent the frames from swaying. It would have to carry the moments and shears due to the lateral wind force to the end walls, and these in turn would have to be braced to carry these stresses to the foundations.

In comparing the economy of rigid frames with that of non-rigid frames, any additional expense for roof and wall framing should be added to the cost of the non-rigid frames.

Professor Hoadley tabulates the weight of three types of frames. The writer wishes to add one more rigid frame as follows: Columns, 10 WF 39; beam 18 WF 50; span, 38 ft; column height 15 ft. The vertical load of 1,140 lb per ft used by Professor Hoadley gives the moment and axial stress at the top of the column as 59,300 ft-lb and 21,700 lb respectively. The fiber stress at the top of the column is 18,800 psi. The moment at the center of the span is 146,700 ft-lb, which is below the capacity of the 18 WF 50 beam.

This frame will weigh 3,070 lb, which is less than the "semi-rigid" frame tabulated by Professor Hoadley. Since codes allow an increase of one-third in the working stress for wind or earthquake conditions, this frame will eliminate extra roof and wall bracing.

Ralph W. Stewart, M. ASCE
Structural Engineer
Los Angeles, Calif.

Rigid frame vs. simple bent

To the Editor: In the article, "Continuity—Asset or Liability?" by Anthony Hoadley in the July issue, a rigid frame is shown to require 18 percent more material than a simple bent to support the same loading. Most of this disparity is due to a poor choice of members for the rigid frame. An 8 WF 35 column does not have sufficient moment capacity to achieve any great reduction in the bending moments in an 18 WF 60 beam. A better choice of members would be a 16 WF 40 beam with 14 WF 48 columns. This combination has sufficient strength to carry the specified loading

If designed by elastic methods, the frame must be assembled with the bottoms of the columns spread $2^1/_2$ in. more than the desired spacing, then pulled together to seat on the anchor bolts. If limit design methods are acceptable, this complication can be dispensed with. The materials required for such a rigid frame are only 5 percent greater than for the simple bent.

A simple beam-and-column bent provides no resistance to lateral forces due to wind or earthquake, hence requires a horizontal bracing truss to transmit forces to braced panels at the ends of the building. Even when made up of light members, this bracing system may be found to require 20 to 30 percent as much material as the bents themselves. The rigid frame provides great resistance to lateral forces in the plane of the bent. As roof live-loads are not considered in combination with lateral forces, and a one-third increase in stresses is allowed in determining resistance to lateral forces, it will usually be found that no increase in size will be required of members proportioned for vertical loads alone.

The rigid frame is likely to permit a shallower beam than the simple bent, with consequent saving in story height. Even with a shallower beam, the rigid frame is stiffer, this being particularly important on long spans, where deflections rather than stresses may determine the sizes of members.

In spite of the factors enumerated above, the simple beam-and-column bent may prove the better solution for a particular application. However, for a valid comparison it is necessary to consider the bent or frame in relation to the structure as a whole.

Marvin A. Larson, A.M. ASCE
Redwood City, Calif.

Wrong affiliation printed for Professor Sollenberger

To the Editor: In my article in the September issue, on the San Marcos Bridge in El Salvador, Central America, "Cable-Truss Design Greatly Increases Stiffness," the wrong affiliation appeared under my name. That given below is my correct title.

Norman J. Sollenberger, A.M. ASCE
Assoc. Prof. of Civil Engineering
School of Engineering
Princeton University
Princeton, N.J.

Editor's Note: This regrettable error is ours, and resulted from one of those compounded confusions that heaps years on editorial shoulders, already stooped.

SOCIETY NEWS

Annual Convention Program Highlights Construction and Young Engineers

In this year that promises to break all construction records New York is notable as the center of much new and vital building. Engineers attending the Annual Convention—to be held at the Statler, October 18-22—will find going up within walking distance of the headquarters hotel such varied structures as a 40-story skyscraper (the behemoth of New York structures since the Empire State Building was erected 20 years ago); a four-story plate-glass bank building with the giant vault fully exposed to street view; a 22-story office building, on which the aluminum facing was placed in less than ten hours; and the perennially interesting United Nations group of buildings and the extensive street relocation and highway construction involved in the development.

Further afield are some projects that can best be viewed from the waterfront, and to bring these within sightseeing range a Friday boat tour of New York Harbor and the Manhattan river front has been arranged. The construction projects along the route include two lift bridges and the Major Deegan Expressway along the Harlem River shore. Pier construction runs the gamut from the new Pier C in Hoboken (one of the largest in the harbor and the objective of a Waterways Division tour on Tuesday afternoon) to a DeLong dock at the Consolidated Edison Company's new Astoria plant. Representatives of the harbor authorities will be aboard to describe new and unusual facilities.

The cruise ship, said to be the last word in luxury, will depart at 11 a.m. *sharp* from Pier 83 on the Hudson River (foot of West 43rd St.). Those making the trip will provide their own transportation to and from the pier. Box luncheons will be served on board, and the price of the lunch ($2.50) will be the only charge for the trip. However, tickets must be purchased before 4 p.m. Thursday, with the sale limited to the comfortable capacity of the boat. Obviously the interest of this trip will not be limited to engineers, and family groups are invited to go along, too, and view the famous Manhattan skyline from the security of a deck chair while the father of the family scrutinizes new construction projects.

Construction Sessions Scheduled

Many facets of modern building will be studied in three Construction Division sessions. Two of these sessions are sponsored by the Division's newly formed Committee on Pipelines, with Maj. Gen. S. D. Sturgis, Jr., M. ASCE, Army Chief of Engineers, making the keynote speech—on pipelines for national defense. Another session covers the use of construction equipment, with attention to choice, capacities, and economy and speakers representing two great United States manufacturers and one Canadian firm. A Thursday afternoon joint session with the Structural Division will make available papers on thin-skin coverings for buildings; thin-shell construction as exemplified by the St. Louis Airport Administration Building; and the projected New York Coliseum. This session will also explore building construction failures.

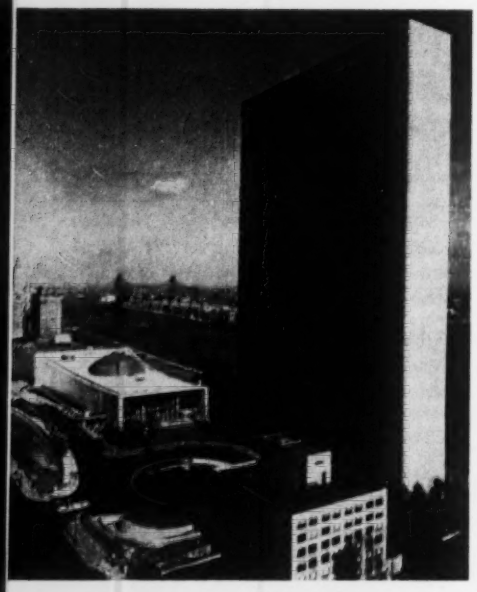
On Thursday the Division will cooperate with the Highway Division in its sponsorship of a Highway Planning Luncheon. Francis V. duPont, U.S. Commissioner of Roads, will be the principal speaker for the event, which will be devoted to one of our most vital national problems.

Employer-Employees Luncheon

The basic relations between employers and their young engineer employees is the theme of an important luncheon, scheduled for Monday, October 18, and of an afternoon "Conditions of Practice Session," that will follow the luncheon. In keeping with the importance of construction in the present-day engineering picture, the luncheon speaker will be Carl B. Jansen, M. ASCE, president of the Dravo Corp. Mr. Jansen, who is an outstanding figure in the construction industry and one-time winner of the Construction Engineering Prize, will discuss the topic, "Construction—an Engineer's Challenge." ASCE Vice-President G. Brooks Earnest, chairman of the Committee on Conditions of Practice, will be toastmaster.

Up for study during the afternoon are such topics as "The Young Engineer in Construction," which will be discussed by Dwight W. Winkelman, M. ASCE, president of the D. W. Winkelman Co., of Syracuse and a former president of the Associated General Contractors, and "Civil Engineering—a Career," which will be handled by Elmer K. Timby, M. ASCE, partner in the New York and Kansas City consulting firm of Howard, Needles, Tammen & Bergendoff. Speaking from the vantage point of the young engineer, William J. Carroll, Jr., J.M. ASCE, of Pasadena, Calif., will describe the younger engineer's attitude toward his economic position, and Robert M. Olson, J.M. ASCE, of Houston, Tex., will discuss the Junior Member's effort to obtain recognition for his ability and effort. Both young men are on consulting engineers' staffs. Sponsoring groups for the luncheon and the "Conditions of Practice Session," are the Society's Committee on Junior Members

Interspersed with the well known structures that comprise the famous Manhattan skyline are many new construction projects under way in the harbor area and along the river front, which will be glimpsed on the Friday boat tour of the waterfront. Those without interest in construction will also find that the cruise aboard a comfortable ship has much to offer.



Situated on a filled-in, beautifully landscaped area on the East River are the United Nations buildings, to which new units are being added from time to time. This impressive group of structures, which can be seen at close range on the Friday boat trip around the island, is also within walking distance of the headquarters hotel. Photo from the New York Convention Bureau.

and the Junior Branch of the Metropolitan Section.

"Kick-Off Party" Monday Night

Another incentive for making an all-week event of the Convention, instead of waiting to get started Wednesday morning (which will feature the usual Society business meeting, presentation of awards, and installation of officers) is the free "Kick-Off Party" Monday from 5:30 to 7:00 p.m. A ticket for the party, complete with drinks and door prizes, will be given to everyone registering Monday. The Metropolitan Section will be the host, courtesy of the engineering firms in the area. Afterwards the Statler is providing tables without cover charge in the Cafe Rouge for Dutch-treat dinner and dancing to the Dorsey Brothers.

The "Kick-Off Party" will set the pace for a week-long program of social events that promises many fresh features as well as new wrinkles to the traditional Wednesday dinner dance and Thursday evening smoker. More good times than usual seem to have been planned for the visiting ladies, too, and some of the most interesting events on their program have the additional merit of being free.

Program in September Issue

The full program of technical and social events was given in the September issue.

City Planning Division Schedules All-Day Meeting in Lehigh Valley

Of particular interest to engineers and planners are the problems that will arise in the use of atomic fuels for the production of power, which will be encouraged by the Atomic Energy Act of 1954, and the impact such practical applications will have on the physical functioning of metropolitan regions. The ASCE City Planning Division, in conjunction with the Society's Annual Convention in New York City, has developed a special program designed to focus attention on the fundamental need for regional planning in the practical development of nuclear fuels. This program will be presented on Friday, October 22, on the campuses of Lehigh University and Lafayette College at Bethlehem and Easton, Pa., respectively.

Program at Lehigh

Five papers will be presented at a morning session opening at 9 a.m. at Lehigh University, and in the afternoon after a luncheon at the Country Club of Northampton County, an open forum discussion, with the morning's speakers sitting as a panel, will be held at Lafayette College. The chairman for the morning session will be Charles A. Blessing, director of the Detroit City Planning Commission and chairman of the executive committee of the Division. The afternoon session will be opened by John McNeal III, president of the Lehigh Valley Section.

Acting as toastmaster at the luncheon will be Francis A. Pitkin, executive director of the Pennsylvania State Planning Board. Dr. Martin Wittaker and Ralph Cooper Hutchison, presidents of Lehigh and Lafayette, will extend greetings, and a speaker of national prominence has been invited to address the luncheon. Cecil F. Dawson, president of the Dixie Cup Co. and coordinator of the Eastern Area Planning Organization, which includes an established regional planning commission, will be the moderator of the afternoon panel discussion.

Program at Lafayette

The speakers and panel members will include John Landis, in charge of customer relations for the Babcock Wilcox Atomic Energy Division, who will outline the general theory and history of the atom, the development of atomic fuel and its use for power production. This will lead to a discussion of the prospects for use of nuclear power by H. W. Huntley, member of the Atomic Power Study of the General Electric Co. Mr. Huntley will cover the design and economics of reactors, the relation of atomic operation to power-load factors in metropolitan areas and the factors entering into the problems of site location. His talk will lead to the subject of the impact of atomic development on the growth and planning of urban regions by Park H. Martin, M. ASCE, executive director of the Allegheny Conference on Community Development in the Pittsburgh regional area. Mr. Martin will explore the possibilities for new rural-urban patterns of land use and population distribution, the desirability of a purposeful relationship between scientific advances and regional planning, and the resulting responsibility which rests with engineers and planners.

The all-important question of the effect of the atom on people will be discussed by Arthur E. Gorman, M. ASCE, sanitary engineer for the Atomic Energy Commission. Mr. Gorman will cover the general public safety in atomic applications, the disposal of radioactive wastes, and the need for exclusion areas and will raise the question of the possibility of effective control through the enforcement of local codes and ordinances. Dr. Harold F. Alderfer, director of the Institute of Local Government at Pennsylvania State University, will explore the adequacy of local governmental structure to meet problems posed by atomic development.

These meetings are not restricted to members of the American Society of Civil Engineers. An invitation to attend is cordially extended to anyone interested in participating. The program has been arranged by J. Cal Callahan, M. ASCE, for the City Planning Division.

Registration and Transportation

Official registration for the meetings to be held in the Lehigh Valley on Friday, October 22, will take place in the lobby of Packard Auditorium of Lehigh University or at Convention headquarters in New York. If room accommodations are desired for Thursday or Friday, reservations will be made at either the Hotel Easton or Hotel Bethlehem, provided a request is received prior to October 19.

Registration will include the lunch at the Northampton County Country Club and will be $5 for Members and $7 for non-Members.

Transportation arrangements will be based on requests received prior to October 19, and will be made at cost. Requests for further information should be sent to: Mr. J. Cal Callahan, M. ASCE, 115 Parker Avenue, Easton, Pa.

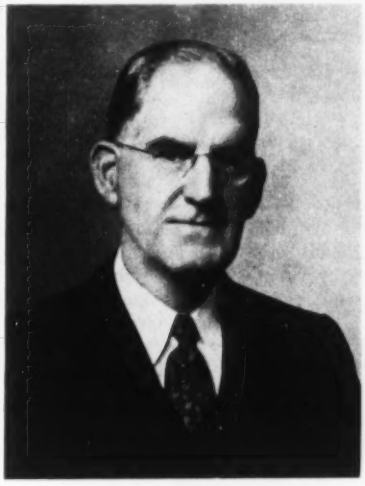
New ASCE Officers to Be Inducted at Annual Convention

Biographies of Nine New Officers

William R. Glidden

The man who will take office in October as 86th President of the Society is William Roy Glidden, assistant chief engineer of the Virginia Department of Highways, with headquarters in Richmond. A member of ASCE since 1922, Mr. Glidden served as Director from 1946 through 1948 and was Vice-President in 1951 and 1952. He has been in the Virginia Department of Highways for 38 years, having gone there in 1916 after early work with the Boston & Maine Railroad, the Metropolitan (Boston) Water and Sewerage Board, and the Massachusetts Highway Commission. In 1912 he was graduated from the Massachusetts Institute of Technology, with the degree of bachelor of science in civil engineering.

Mr. Glidden became assistant chief engineer of the highway department in 1952 after 35 years as bridge engineer. During his long tenure in the department, the annual bridge appropriation for Virginia roads has increased from a modest beginning to many millions. In a recent organizational change in the department, Mr. Glidden was placed in charge of all technical services, including the divisions of Bridges, Location and Design, Testing of Materials, Research, also Secondary Roads. He continues in charge of the Revenue Bond Projects, including the Hampton Roads Bridge-Tunnel Project and the Rappahannock River Bridge Project at Greys Point. For many years Mr. Glidden was on the faculty of the Virginia Mechanics Institute in Richmond and had special engagements with the University of Virginia and Virginia Polytechnic Institute.



WILLIAM ROY GLIDDEN
President-Elect of ASCE

In addition to his service on the ASCE Board of Direction, Mr. Glidden has been active in the Virginia Section, of which he is a past-president. He was one of the founders of the Virginia Society of Professional Engineers and active in its formative years. He also belongs to the National Society of Professional Engineers, the American Concrete Institute, the American Association of State Highway Officials, the Southeastern Association of State Highway Officials, and the Highway Research Board.

In recognition of his work in the field of applied science, Mr. Glidden was elected to membership in the University of Virginia chapter of Sigma Xi, national honorary science fraternity.

Mr. Glidden has made important contributions to the evolution of highway bridge engineering during the past generation through his own practice and through membership on various technical committees. He is also well known as a lecturer on engineering subjects at colleges and universities and before professional societies throughout the United States. Certified as a professional engineer in the state of Virginia, he has been invited to act as consultant on special problems to other engineers and architects in the state.

Frank L. Weaver

Frank L. Weaver, newly elected Vice-President for Zone II, is a civil engineering graduate of the University of Michigan, class of 1913. He spent most of his professional life in Michigan until his return to his native city of Washington, D.C., twenty years ago when he became a member of the staff of the Federal Power Commission. His early career included civil engineering teaching at the University of Oklahoma and Johns Hopkins University and work on hydroelectric power developments with the late ASCE Vice-President Gardner S. Williams in Ann Arbor and with Clarence W. Hubbell on the Detroit sewage problem. In World War I he served as captain in the 305th Engineers, 80th Division, taking part in the Somme, St. Mihiel, and Meuse-Argonne offensives.

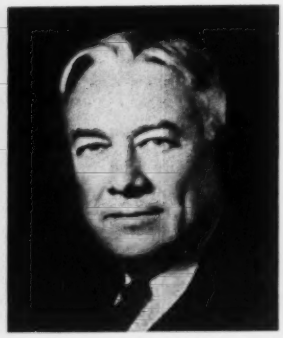
After the war Mr. Weaver rejoined Mr. Hubbell and was continuously engaged in general consulting practice in Detroit for the next fifteen years. During this period he was closely connected with the variety of engineering problems associated with the rapid growth of the city and neighboring communities. As city engineer of Wyandotte, Mich., during the same period he was also responsible for that city's program of municipal improvements.

Since 1934 Mr. Weaver has been associated with the Federal Power Commission—since 1938 on its work in river development, particularly in connection with hydroelectric power. He has been active in the Federal Inter-Agency River Basin Commission since its organization in 1943. In 1950 Mr. Weaver was named an engineer-adviser to the President's Water Resources Policy Commission and subsequently served on the Bureau of the Budget's Inter-Agency Water Policy Review Committee.

In addition to his duties as chief of the Division of River Basins in the Federal Power Commission's Bureau of Power, Mr. Weaver served as the Commission's representative on the New England-New York Inter-Agency Committee from 1951 to March 1954. In March, at the request of the Hoover Commission on Organization of the Executive Branch of the Government, the Commission granted him a leave of absence to join the staff of the Task Force on Water Resources and Power as special adviser on power. He is currently engaged on this special assignment.

Elected a Junior Member of ASCE in 1916, Associate Member in 1920, and Member in 1936, Mr. Weaver has served a term as Director representing District 5. As a member of the Board, he was on the Committee on Coordination of Professional Activities and the Committee on Professional Conduct and was Contact Member for the Committee on Local Sections. He has also held all the elective offices in the District of Columbia Section. His other memberships include the United States Committee on Large Dams of the International Commission on Large Dams, the American Geophysical Union, the Washington Society of Engineers, the Cosmos Club, Tau Beta Pi, and Sigma Xi.

FRANK L. WEAVER
Vice-President, Zone II



LOUIS R. HOWSON
Vice-President, Zone III

JEWELL M. GARRELTS
Director, District 1

FREDERICK H. PAULSON
Director, District 2

Louis R. Howson

A consulting engineer of note, Louis R. Howson, newly elected ASCE Vice-President for Zone III, is a partner in the Chicago consulting firm of Alvord, Burdick & Howson. He has been connected with the organization since his graduation from the University of Wisconsin.

Mr. Howson has advised on water supply for Chicago, New York, Milwaukee, Denver, Montreal, and the Atomic Energy Commission. Has been consulted on waste disposal by the Milwaukee Sewerage Commission, the Toronto Metropolitan Commission, Roanoke, Va., Gary, Ind., and Winnipeg, Canada. He was chief sanitary expert for New York, Pennsylvania, Ohio, Michigan, Wisconsin and Minnesota on four U. S. Supreme Court hearings relating to diversion and sewage treatment at Chicago. He has testified before most of the State Regulatory Commissions, the Interstate Commerce Commission, and numerous state and federal courts on matters relating to public utility valuation and rates.

Becoming an Associate Member of the Society in 1914 and Member in 1922, Mr. Howson served as Director from 1949 to 1953. His committee services include chairmanship of the Publications, Awards and Ceremonies, and Advisory on EJC Water Policy Panel committees. He has been a member of the Committee to Study Board Reorganization, and of the Technical Procedure, Division Activities, and Professional Conduct committees. He is a past-president of the Western Society of Engineers, and past-president and honorary member of the American Water Works Association.

Jewell M. Garrelts

The new ASCE Director for District 1 will be Jewell M. Garrelts, professor and executive officer in the Columbia University department of civil engineering, New York. After graduating from Valparaiso University in Indiana with a B. S. degree in 1924, he worked for one year with the Illinois Steel Co. in Gary, Ind. He then (1925) went to Cornell University as instructor in structural engineering, and in 1927 became an instructor in mechanics at Columbia University where he has continued his academic work. During summer vacations, and in a part-time capacity during the academic year he has practiced structural engineering with the Concrete Steel Co., the American Bridge Co., and Hardesty & Hanover, and since 1951 has practiced as a consultant to Briggs, Blitman and Posner, Consulting Engineers.

Becoming an Associate Member of ASCE in 1937 and a Member in 1943, Professor Garrelts has served the Society as a member of the Executive Committee of the Structural Division for five years; secretary of the Structural Division for several years; chairman of the Task Committee to Study Technical Division Structure; member of the Committee on Junior Members; and director of the Metropolitan Section. For the past five years he has been a member of the ASCE Annual Convention Committee, and is Convention chairman this year. He is also secretary of the Reinforced Concrete Research Council and adviser of the Columbia University Student Chapter of ASCE.

Frederick H. Paulson

The Director-elect for ASCE District 2 is Frederick H. Paulson, of Providence, R.I. A native of Rhode Island, Mr. Paulson graduated from Brown University in 1920 with the degree of bachelor of science in civil engineering. For the next fifteen years he was an industrial engineer for F. P. Sheldon & Son, consulting engineers of Providence, specializing in structural design. In this capacity he was responsible for the design of many varied types of industrial structures erected in the Eastern and Southern states and for several South American buildings. In 1935 he became chief engineer for Oresto DiSaia, A. I. A., whose commissions included several theaters and many institutional and private buildings.

Since 1940 Mr. Paulson has been with Charles A. Maguire & Associates of Providence as chief structural engineer, and has played a prominent part in the growth of that office into one of the largest consulting engineering firms in the East. During the war years, Mr. Paulson was manager of the firm's Newport office, which executed plans and designs for many millions of dollars worth of Naval Base construction. For his part in this work the Navy Bureau of Yards and Docks, in 1944, cited him for "outstanding cooperation and loyalty" and awarded him the Meritorious Civilian Service emblem. Since the latter year Mr. Paulson has been manager of the firm's Providence office, and is now a partner in the concern, which has handled many of the largest engineering jobs in New England.

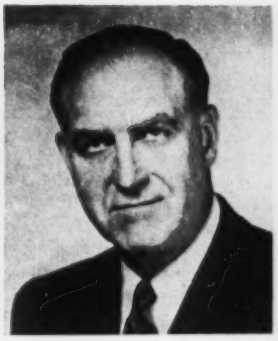
Elected to Junior Membership in ASCE in 1924, Mr. Paulson became an Associate Member in 1927 and a Member in 1942. He has long been active in the Providence Section, which he served as secretary-treasurer from 1935 to 1947 and as president in 1949 and 1950. He is now on the Section's Board of Directors, and was one of the sponsors of the newly formed New England Council of Sections. At present he is also on the Society's Membership Qualification Committee for Rhode Island, and is the Contact Member for the Brown University Student Chapter.

Mr. Paulson has also been active in other professional groups. He is a member of the National Society of Professional Engineers and has been director and president of the Rhode Island state society; a member of the Providence Engineering Society, and a former member of its Council; and a member of Tau Beta Pi, the Boston Society of Civil Engineers and the Brown Engineering Association.

GEORGE S. RICHARDSON
Director, District 6

DON M. CORBETT
Director, District 9

GRAHAM P. WILLOUGHBY
Director, District 10



LAWRENCE A. ELSENER
Director, District 11

George S. Richardson

George S. Richardson, ASCE Director-elect for District 6, is a graduate of the University of Colorado, from which he holds degrees of B.S. in C.E. (1920) and C.E. (1926). His early experience included field work with the Wyoming and Pennsylvania Highway Departments, a year as instructor in civil engineering at the Towne Scientific School, University of Pennsylvania, and as a draftsman with the McClintic-Marshall Co. and the American Bridge Co.

From 1924 to 1937 Mr. Richardson was with various public works agencies in Allegheny County at Pittsburgh, becoming assistant chief engineer of the Allegheny County Department of Public Works. His work during this period included a number of major bridges, such as the George Westinghouse concrete-arch spans, the West End tied arch over the Ohio River, and the Homestead Bridge over the Monongahela River.

In 1937 he entered private practice—for a short period as junior partner in Frick & Richardson, Pittsburgh, and for fifteen years as consultant and senior partner in the firms of George S. Richardson, Pittsburgh; Richardson and Gordon, Philadelphia; and Richardson, Morehouse, Ramsey and Fisher, Pittsburgh. The principal work of these firms is the planning, design, and supervision of construction of expressways, turnpikes, and highway bridges. Recent work has included Downtown Interchanges of the Penn-Lincoln Parkway East and West in Pittsburgh, the Beaver River Bridge on the Pennsylvania Turnpike, and the Delaware River Bridge connecting the New Jersey and Pennsylvania turnpikes.

A member of ASCE since 1925, Mr. Richardson has served the Pittsburgh Section in many capacities, including a term as president.

Don M. Corbett

Don M. Corbett, newly elected ASCE Director for District 9, is widely known for his contribution to hydrology over a period of thirty years of continuous service with the U. S. Geological Survey in Utah, Texas, Alabama, Massachusetts, Tennessee, Washington, D.C., and Indiana. He has been an adopted Hoosier since his appointment as district engineer at Indianapolis, Ind., in September 1941. Mr. Corbett is co-author of numerous Water Supply Papers for the Illinois, Ohio, and Great Lakes Basins, and principal author of Water Supply Paper 888, a manual describing technical methods and practices of the Surface Water Branch of the Survey. He is an alumnus of Utah State Agricultural College.

Becoming an Associate Member of ASCE in 1930 and Member in 1946, Mr. Corbett served the Indiana Section as vice-president and president in 1950 and 1951, and contributed greatly to the organization and development of the Section's Northwest Sub-Section, which was chartered October 2, 1951.

From May 1951 to May 1953, Mr. Corbett was vice-president and president of the Indiana Engineering Council, established in 1881 and comprising nine member organizations including state and local sections of national societies of mechanical, electrical, civil, and professional engineers. At present he is representing the Indiana Section of the Society as delegate to the District 9 Council and the Indiana Engineering Council as delegate to the Building Congress of Indiana, Ind.

Graham P. Willoughby

Graham P. Willoughby, plant engineer for the American Bridge Division of the U. S. Steel Corp., at Birmingham, Ala., is ASCE Director-elect for District 10. A civil engineering graduate of Alabama Polytechnic Institute, Mr. Willoughby's early experience consisted of a year as draftsman in the Duval County (Florida) Bridge Department and six years as draftsman, designer, and estimator in the structural steel business in Birmingham. For the next ten years he was designer, resident engineer, project engineer, assistant bridge engineer, and bridge engineer for the Alabama Highway Department, with headquarters at Montgomery.

During the war Mr. Willoughby served as lieutenant and lieutanant-commander in the Navy Civil Engineer Corps, with two years overseas duty with the Seabees. For the past nine years he has been with the Virginia Bridge Co. and the American Bridge Division of U. S. Steel, as designer, construction engineer, division engineer, and plant engineer. As plant engineer for the American Bridge Division of U. S. Steel, he is currently in charge of the designing and estimating office and the structural drafting room in Birmingham.

Joining the Society as an Associate Member in 1938, Mr. Willoughby became a Member in 1954. He has held every elective office in the Alabama Section, culminating in the presidency in 1952. He is also a member of the Birmingham Engineers Club and the Birmingham Chamber of Commerce.

Lawrence A. Elsener

Lawrence A. Elsener, ASCE Director-elect for District 11, is a native of Indiana and a civil engineering graduate of Purdue University. Mr. Elsener has been connected with the Chicago Bridge & Iron Co. since 1922—successively in the drafting and engineering departments. Starting as a foreman at the company's Greenville, Pa., plant, Mr. Elsener has been in the Chicago district contracting office, contracting engineer in the San Francisco office, district sales manager in San Francisco, and since 1952 vice-president in San Francisco.

Becoming an Associate Member of the Society in 1927 and a Member in 1942, Mr. Elsener has been active in the San Francisco Section, which he served as president in 1948. He was Convention

chairman for the Society's Annual Convention in San Francisco in March 1953. He has also been president of the Engineers' Club of San Francisco, and is currently serving as regional vice-president of the Steel Plate Fabricators' Association of America.

Mr. Elsener's other affiliations include the American Petroleum Institute, the American Water Works Association, and the Pacific Coast Gas Association. He is also a member of the Triangle, Sigma Xi, and Chi Epsilon fraternities.

Tellers Canvas Ballot For 1955 ASCE Officers

September 15, 1954

To the 1954 Annual Meeting

American Society of Civil Engineers:

The Tellers appointed to count the Election Ballots for Officers of the Society for 1955 report as follows:

For President

(Term October 1954–October 1955)

William Roy Glidden	10,948
Scattering	35
Void	16

For Vice-President—Zone II

(Term October 1954–October 1956)

Frank L. Weaver	2,491
Scattering	11
Void	3

For Vice-President—Zone III

(Term October 1954–October 1956)

Louis R. Howson	1,936
William D. Dickinson	1,209
Scattering	4
Void	26

For Director—District 1

(Term October 1954–October 1957)

Jewell M. Garrelts	800
Stanley M. Dore	553
Scattering	1
Void	11

For Director—District 2

(Term October 1954–October 1957)

Frederick H. Paulson	563
Scattering	6
Void	2

For Director—District 6

(Term October 1954–October 1957)

George S. Richardson	778
Scattering	3
Void	1

For Director—District 9

(Term October 1954–October 1957)

Don M. Corbett	649
Scattering	2
Void	1

For Director—District 10

(Term October 1954–October 1957)

Graham P. Willoughby	851
Scattering	22
Void	0

For Director—District 11

(Term October 1954–October 1957)

Lawrence A. Elsener	1,717
Scattering	5
Void	2

Ballots counted	22,646

Ballot envelopes rejected:

Without signature	124
Dues in arrears	45

Respectfully submitted,

Joel E. Fisher, Jr., *Chairman*
Albert P. Loriot, *Vice-Chairman*

Raymond L. Bartholomew
Herman Birman
Louis J. Capozzoli, Jr.
Victor Feigelman
William J. Funge
Samuel L. Gatslick
Howard Grill
Donald A. Kirchhofer
Arthur R. Luecker
Carl F. Rupp
Charles R. Walter
Tellers

International Cooperation Stressed at Upadi Convention

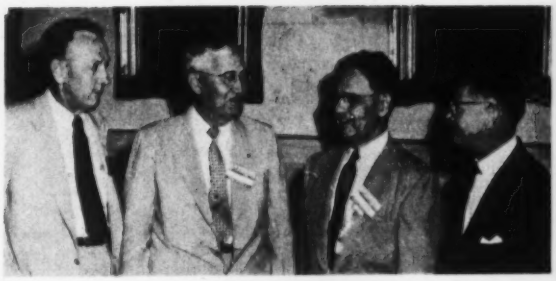
Delegates to the third UPADI convention, held in Saõ Paulo, Brazil, August 2–6, were impressed again with the mutually beneficial effectiveness of cooperative assemblies of professional men of free nations. An example was the reactivation of the Pan-American Committee on Standardization with a view to development of an inter-American program of standards, with committee headquarters in Rio de Janeiro.

The convention favored maintenance of liaison between UPADI and the Organization of American States, which has an office in Washington. It was recommended that each society in UPADI strive in its own country to organize a consultative technical council for a study of the nation's natural resources with a view toward national works programs. Extended discussion revolved around engineering education and the distribution of data on that subject among UPADI members. EJC has furnished UPADI with complete information on engineering education in the United States obtained from the government.

Several ASCE members were in the EJC group that took in tours arranged for general sightseeing and for observation of major engineering projects. Saõ Paulo itself, of course, is a veritable monument to engineering achievement with its many new structures, belt roads, great industrial area, and hydroelectric works. The attendance included representatives from 17 Western Hemisphere countries, with 35 from the United States.

The next convention will be in Mexico City in 1956.

At the closing session of the UPADI Convention in Sao Paulo, James M. Todd (left), head of the EJC delegation, presented to Henrique Pegado, chairman of the Brazilian delegation and president of the Saõ Paulo Institute of Engineers, a copy of the Centennial of Engineering volume issued by ASCE following its 1952 centennial program in Chicago.



Snapped at the Hydraulics Division luncheon (left to right in left-hand view) are William F. Guyton, of the Division's Hydrology Committee; Joseph Tiffany, member of the Division's executive committee; ASCE Director Raymond F. Dawson; and R. L. Lowry, general meeting chairman. The get-together at the right shows (in usual order) ASCE Vice-President Mason Lockwood; President Daniel V. Terrell; Professor Dawson; and Reed Granberry, of the Governor's staff, who extended official greetings to the group.

Texas Section's Austin Branch Host To Hydraulics Division Meeting

With an attendance topping the 200 mark, the Hydraulics Division had an enthusiastic and successful meeting at Austin, Tex., September 8–10. The group was officially welcomed to Austin and to Texas by Reed Granberry, of the Governor's staff, who is himself an engineer.

Hydraulics Division Chairman G. H. Hickox told the meeting how the Division is organized and carries out its program of activities. More than 150 members are now actively at work carrying out the Division program through administrative committees and task forces. Two manuals are in preparation—one on sedimentation and one on gates for hydraulic structures. Mr. Hickox invited members to volunteer for Division work, of which there is plenty.

The Division luncheon was attended by ASCE President Daniel V. Terrell, Vice-President Mason Lockwood, and Director Raymond F. Dawson. In brief talks, Mr Lockwood welcomed the meeting to his home state, and Dean Terrell discussed the Society's future plans as they are shaping up with the funds available from increased dues revenues.

General Chairman Robert L. Lowry took time off from his official duties to describe the latest "big" in Texas floods—the unprecedented flood of July 1954 on the Rio Grande. The rainfall, which was 40 in. in places, in 48 hours produced such phenomena as a 98-ft rise in the Pecos River and a discharge exceeding 1,000,000 cfs. Karl F. Keeler, hydraulic engineer for the International Boundary Commission, added to the vivid description of the flood his impressions of the disaster on the Mexican side of the river obtained by looking through binoculars from the Texas side. He saw people climb to the roofs of their adobe houses with lighted lanterns in their hands. As the flood waters rose around the houses the adobe melted, the lights went out, and the people in most cases drowned.

Five technical sessions covered subjects from flood studies to sedimentation. Friday afternoon and Saturday morning were given over to inspection trips to the University of Texas, the state capitol, and the chain of reservoirs and hydro-projects of the Lower Colorado River Authority. The social highlight of the meeting was a trip up Lake Austin on the paddle-wheel steamer "Commodore" to Green Shores for a barbecue and Texas-style entertainment. The return trip by moonlight with the sky resplendent with stars will long be remembered by those fortunate enough to make the trip.

The meeting sent greetings to ASCE Past-President J. C. Stevens, of Portland, Oreg., who was unable to be present. Mr. Stevens was active in the Division for many years.

Much credit for the success of the meeting goes to Branch President Walter Moore and to his hard-working and efficient committees. Vice-chairman John H. Montgomery called the signals, and his committees functioned to great advantage. Special credit goes to Mrs. Trigg Twitchell for her handling of the ladies' program, which offered a round of tours, luncheons, coffee hours, and other features. John A. Focht handled finances, registration, and reception with great efficiency. The management of the Driskill Hotel also cooperated enthusiastically, making sure that there was evidence of Texas hospitality at every turn.

[Albert S. Fry, secretary of the Hydraulics Division, supplied material for this write-up of the Hydraulics Division meeting.]

Intermountain Section Host to ASCE Irrigation and Drainage Conference

Some 130 engineers from Canada to Texas and from New Jersey to California took part in the Irrigation and Drainage Conference, held at Salt Lake City, Utah, September 9–11, and voted the meeting a huge success. Technical sessions on Thursday and Friday included fourteen papers covering a number of phases of irrigation system maintenance and operation and ground-water hydraulics. The subjects of "Use and Control of Ground Water" and "Drainage Problems Associated with Irrigation" provoked the most extensive discussion.

The Friday dinner that concluded the two-day technical program featured a talk by William R. Wallace, president of the Utah Water Users Association. George D. Clyde, the conference chairman, was toastmaster.

To supplement one group of papers there was a Saturday field trip to the Bureau of Reclamation's Weber Basin Project, where construction activities on Wanship Dam, the Gateway Tunnel, and the Hoover Pilot Drain were in full swing. The trip took the group over the old Mormon Trail.

The conference was sponsored jointly by the Irrigation and Drainage Division and the Intermountain Section.

Seated at the head table at the Irrigation and Drainage Division dinner are (left to right): Mrs. Herbert E. Prater; Herbert E. Prater, secretary, executive committee, Irrigation and Drainage Division; Mrs. A. P. Rollins; A. P. Rollins; Mrs. George D. Clyde; George D. Clyde, toastmaster and conference chairman; William R. Wallace, speaker of the evening; Miss Elam M. Wallace; Mr. and Mrs. H. W. Chase; Walter E. Blomgren, chairman, executive committee, Irrigation and Drainage Division; Howard T. Critchlow and George N. Carter, members of the executive committee. Shown in the same order at the sub-head table are Mr. and Mrs. M. T. Wilson, Mrs. C. D. Gessel, C. D. Gessel, Mrs. J. W. Odell, and J. W. Odell. Glimpsed at the conference luncheon (left) are H. E. Prater, W. E. Blomgren, G. K. Borg, and Dr. C. J. Christensen.

ECPD Issues Revised Booklet on Engineering

Availability of a second edition of its popular career-guidance pamphlet for engineers is announced by the Engineers' Council for Professional Development. Entitled *Engineering—A Creative Profession*, the 31-page illustrated bulletin clearly and graphically explains just what engineering is; patterns common to all fields of engineering; the necessary educational background; how to go about getting an engineering job; the difference between the various fields of engineering; and the proper choice of a college as the starting point in a professional career. A two-page bibliography of recommended reading is included.

Copies of the pamphlet sell for 25 cents, with a 40 percent discount available on orders of fifty or more copies. Inquiries should be sent to ECPD, 29 West 39th Street, New York 18, N.Y.

ASCE MEMBERSHIP AS OF SEPTEMBER 9, 1954

Members	8,759
Associate Members	11,246
Junior Members	17,966
Affiliates	70
Honorary Members	44
Total	38,085
(September 9, 1953	36,808)

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

The **Arizona Section** went on record as opposing the use of competitive bidding as a means of selecting professional engineers in a resolution passed during its summer meeting at Flagstaff on August 21. About 70 attended the all-day session, which featured a tour of the Southwest Lumber Company's new milling facilities. Of particular interest to the group was the span of roof trusses for the building, one of the largest of its kind in the state. Speakers were Walter Johannessen, Phoenix consultant, who described his work in designing the Phoenix municipal airport; Charles W. Dryden, of the Arizona Engineering Co., who discussed uranium prospecting; and Henry Giclas, of the Lowell Observatory, who spoke on outer space during an after-dinner visit to the observatory. Elmer J. Maggi, of Phoenix, was meeting chairman.

Entertainment at the **Georgia Section's** annual summer outing for the ladies, which was voted a great success, consisted of golf and swimming followed by a barbecued chicken dinner and one-act play, directed by Col. Harold E. Bisbort, of the Corps of Engineers, which revealed much unsuspected amateur talent. Square and social dancing rounded out the evening.

Looking ahead to February, the **Hawaii Section** invites members attending the San Diego Convention to an all-day island-wide meeting to be held February 15. Plan your vacation to coincide with this date, says the Section, and come directly from the Convention. Details may be obtained from John R. Evans, of the University of Hawaii, Honolulu 14, Hawaii.

Something new was tried by the **Louisiana Section** and the Louisiana Engineering Society early in August, when they sponsored a state-wide public works program, in which members could participate from any of six cities in the state by means of a telephone and public address hook-up. Speakers on the evening panel included Roy T. Sessums, director of the Louisiana State Department of Public Works at Baton Rouge; Louis C. Bisso, director of city planning for New Orleans; and Lane Mitchell and Charles B. Foster, commissioner of parks and streets and engineer of water and sewerage for Shreveport. Dean Lee Johnson, of Tulane University, was moderator. Summer doings of the **Shreveport Subsection** included a field trip through the Lone Star Steel Mill at Daingerfield, Tex., and a stag social.

A. E. Johnson, chief engineer of the Arkansas Highway Department, explored the engineer's role in the civil defense program in the principal talk at the August 18 meeting of the **Mid-South Section's Little**

Attending the fourth annual meeting of the Maine Section, held in Hallowell on August 6, are (seated left to right) Frederick H. Paulson, ASCE Director-elect for District 2; Hamilton Gray, president of the Maine Section; and ASCE President Daniel V. Terrell. Standing (in the same order) are Neal D. McDowell, member of the New England District Council; Charles B. Breed, professor emeritus of civil engineering at M.I.T.; Lucius D. Barrows, chief engineer of the Maine State Highway Department; and Warren F. Daniell, secretary-treasurer of the Section's New Hampshire Branch. There were 69 present for the all-day session, at which President Terrell gave a résumé of Society activities at the national level and discussed additional services that may be available with the extra income received from the dues increase. Actions taken by the Section included the passing of a resolution honoring Mr. Barrows for his long service to "the people of the State of Maine as an engineer in the Maine State Highway Department." On August 7 President Terrell was taken on a deep-sea fishing expedition out of Boothbay Harbor that was reported a great success.

Rock Branch. He stated that while civil defense work is of vital importance in both peace and war, Arkansas is in the present unfortunate situation of having no funds available for setting up a working civil defense program.

N. W. Beezley is the new secretary-treasurer of the **Nebraska Section.** He succeeds Arnold I. Johnson, who has been obliged to resign because of the removal of the USGS Hydrology Laboratory, of which he is chief, to Denver. Mr. Beezley is a civil engineer in the office of the Lincoln city engineer. In a talk on "Magnitude and Frequency of Floods in Nebraska," given at a recent meeting, L. W. Furness, hydraulic engineer for the U.S. Geological Survey, said that when the effect of size of drainage area is cancelled out, some of the recent Nebraska floods have been equalled or exceeded only a few times in the entire United States. Factors which might affect flood crest, he said, are shape of drainage area, slope, topography, soils, and land use.

There was a turnout of 210 for one of the **Sacramento Section's** weekly luncheon meetings, the attraction being a talk by C. Biemond, director of public water works for Amsterdam, Holland. Mr. Biemond explained the meterorological background of the Netherlands superflood of February 1953 and described the engineering problems involved in the tremendous task of closing the breaches in the dikes. As a member of the Zuyder Zee Board and the Dutch Water Conservation Board, Mr. Biemond has been closely connected with the problems involved in reclamation of his country's flooded lowlands. He has recently been in Sacramento as consultant to the California Water Project Authority, which is conducting an investigation of the salinity-control barrier proposed for San Francisco Bay. At its August meeting the **Junior Forum** heard the pros and cons of a proposal calling for radical revision of the examining procedures for engineering registration in the state, with Ernest D. Francis representing the California Association of Structural Engineers and D. Jackson Faustman presenting the view of the Section's legislative committee. After spirited discussion, moderated by R. Robinson Rowe, the Forum expressed itself solidly against any sweeping revision of the examination procedure.

Sessions of the **South Carolina Section's** summer convention—held during a two-meeting of the South Carolina Society of Engineers in Charleston in August—were held aboard the cruise ship, *Dixie Queen*. Trips to Fort Sumter and up the Ashley River were followed by a social hour, a buffet supper, and a dance on deck. During the business meeting a committee was appointed to investigate the feasibility of forming a Subsection in the Charleston area. More than 200 members and guests made the most of the novel program.

Coming Events

Cincinnati—Meeting in the Engineering Societies Building, October 6, at 8 p.m. Meeting on water resources, November 3.

Illinois—Weekly luncheon meetings featuring ten-minute speeches, at the Chicago Engineers Club, 314 South Federal St., every Friday at 12 noon.

Iowa—Joint meeting with the Engineers Club of Iowa City, October 25, 6:30 p.m. All-day annual meeting at the Hotel Fort Des Moines, Des Moines, November 18.

Los Angeles—Joint dinner meeting with the Sanitary Engineers Group in the Rodger Young Auditorium, October 13, 6:30 p.m. Call Secretary Martin Duke at Bradshaw 2-6161 for reservations. Meeting of the **Junior Forum** in the Rodger Young Auditorium, October 13, 6 p.m. Meeting of the Transportation Group in Room 2, State Division of Highways Building, 120 South Spring St., October 20, 7:30 p.m.

Maryland—Meeting at the Engineers Club, Baltimore, October 13.

Metropolitan—Meeting in the auditorium, Engineering Societies Building, 33 West 39th St., November 17, 7 p.m. Meeting of the Junior Branch in the Engineering Societies Building, November 10, 7 p.m.

Mid-South—Annual meeting at the Hotel Lafayette, Little Rock, Ark., October 21–23. There will be an "Early Birds" party on the evening of the 21st.

Oklahoma—Annual meeting at Stillwater, Okla., November 27.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon. Meeting of the **Central Valley Subsection** in the Engineering Building, College of Pacific campus, October 20.

Scheduled ASCE Conventions

NEW YORK CONVENTION
New York, N.Y.
Hotel Statler
October 18–22, 1954

SAN DIEGO CONVENTION
San Diego, Calif.
Hotel U. S. Grant
February 6–11, 1955

ST. LOUIS CONVENTION
St. Louis, Mo.
Jefferson Hotel
June 13–17, 1955

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

The following will serve as a convenient summary of legislation of interest to civil engineers, which was enacted during the recent session of Congress:

P.L. 313—Indirectly aids sanitary engineering officers of Army Medical Service Corps by removing statutory limitations on the number of colonels.

P.L. 325—Authorizes construction of an Air Force Academy at Colorado Springs. Architectural and engineering firms are now engaged in planning.

P.L. 350—Federal-Aid Highway Act of 1954. New billion-dollar-a-year highway authorizations.

P.L. 356—Assures judicial review of disputes on government contracts. Aftermath of the "Wunderlich" case.

P.L. 358—Authorizes U. S. participation in the St. Lawrence Seaway project and establishes the St. Lawrence Seaway Development Corp. Corps of Engineers will play leading part in administering construction.

P.L. 363—Authorizes increases on Columbia River Basin work.

P.L. 371—Authorizes construction of aeronautical research facilities in Virginia, California, and Ohio.

P.L. 431—Amends Contract Settlement Act of 1944 by establishing a 180-day time limit for filing certain claims thereunder.

P.L. 482—Broadens the Hospital Survey and Construction Act to include grants to states for diagnostic centers, certain hospitals and nursing homes.

P.L. 498—Extends the Alaska Public Works Act.

P.L. 519—Authorizes the General Services Administration and the Post Office Department to provide for the construction of public buildings through lease-purchase contracts; in effect to purchase government buildings on an installment basis. Twenty-three projects have already been approved by the House Public Works Committee.

P.L. 530—Authorizes state and White House conferences on educational and school building needs.

P.L. 534—Authorizes large military construction program at home and abroad.

P.L. 540—Authorizes new irrigation works in Washington (on Chief Joseph Dam project).

P.L. 547—Authorizes irrigation project in California (Santa Margarita).

P.L. 560—Housing Act of 1954. Deals with FHA mortgage insurance program; authorizes public housing and funds for slum clearance and urban renewal. Also authorizes advance planning of public works. (Although $10 million was authorized for advance planning only $1.5 million was appropriated for advances to state and local public bodies.)

P.L. 566—Provides for soil-conservation work by local agencies in cooperation with Department of Agriculture.

P.L. 591—Internal Revenue Code of 1954. General revision of the tax laws. Allows among its many features for accelerated depreciation on plant and equipment; for exemption from income tax of earnings up to $20,000 a year for those remaining abroad for 17 months.

P.L. 597—Extends provisions of the Water Conservation Act of 1947, formerly restricted to the arid regions, to all parts of the country.

P.L. 598—Authorizes group life insurance for federal employees.

P.L. 606—Authorizes work on Rogue River, Oregon.

P.L. 612—Authorizes work on Missouri River.

P.L. 703—Atomic Energy Act of 1954. Permits nongovernmental use of fissionable materials for developing energy for commercial peaceful purposes.

P.L. 731—Extends federal aid for school construction for three years in defense areas.

P.L. 764—Contract Renegotiation Act is extended through 1954. Amended so that minimum of defense contracts to require renegotiation is raised from $250,000 to $500,000 per year, thus eliminating a vast majority of engineers from renegotiating requirements.

P.L. 780—River and Harbor Act of 1954. Authorizes river and harbor and flood control projects which will cost more than $1 billion.

Social Security Amendments of 1954 (P.L. 761)

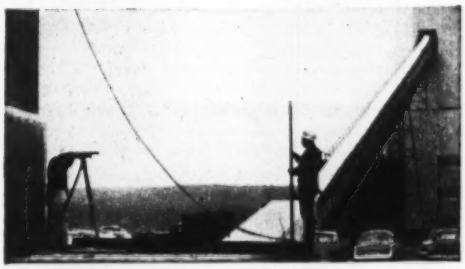
This legislation followed one of the hardest-fought conference sessions in years. The Senate had passed a bill excluding professional workers from coverage. In conference the House representatives were adamant and after a prolonged deadlock, a compromise resulted in doctors and lawyers being excluded while engineers and architects were included. The principal reason leading to this result was that so few engineers would be affected, as the vast majority of professional engineers and even a large percentage of self-employed engineers have already been covered by Social Security. The opinion among self-employed engineers was divided as to the desirability of coverage. ASCE and EJC testified in support of voluntary coverage and in opposition to mandatory coverage.

The greatest gain made on behalf of professional men was the lowering of the age limit, from 75 to 72 years, at which Social Security income could be received regardless of outside earnings. Minor gains included the raising of permissible outside earnings to $1,200 a year and elimination of the lowest four years in figuring average salary. A provision of great importance to professional workers, who rarely fully retire, is the new proviso that one may receive Social Security income for any month in which he performed no work. Thus despite the annual-earnings limitation, if a self-employed person receiving Social Security income earned even $5,000 on a three-month engagement and did no work in the remaining nine months, he would be entitled to receive Social Security income for those nine months. The regulations to be worked out governing this provision may possibly narrow it somewhat.

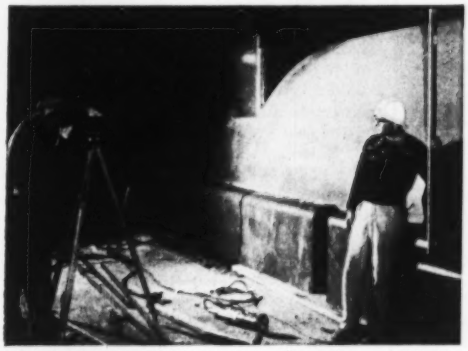
The work of the engineering societies in advising House and Senate committees produced some results very favorable to the profession, although in many other instances our recommendations were not followed.

Washington, D. C.
September 16, 1954

CHECKING ALIGNMENT of the turbine throttle valve with Berger 6" Transit; grade set with Berger Level. Tolerances 1/32" in any direction.



ESTABLISHING GRADES for setting reclaim hopper with Berger Level.



CHECKING TURBINE GENERATOR to elevation within ±1/32" with a Berger Level.

From project base line to complete power plant installation...

Berger Instruments point the way for Stone & Webster engineers

"In laying out a power plant like this for The Hartford Electric Light Company, 1/32" is a critical dimension – whether you're establishing the initial project base line or aligning the turbine throttle valve – because all buildings and equipment must be accurately integrated into one operating unit," say the field engineers at Stone & Webster Engineering Corporation.

Berger Transits and Levels were used exclusively on this job – to meet these requirements:

All building base plates set for line and grade within a tolerance of 1/32".

Anchor bolts for coal handling equipment set to 1/16" to assure perfect fit in field erection of prefabricated sections.

Alignment and elevation of main and auxiliary steam lines set under strain within 1/16" in order that they will assume their proper position after expansion takes place when lines become operative at a temperature of 950° F. Deviation from dead level held within ±1/32".

Center lines for all equipment — piping, generators, boiler feed pumps, pulverizers, condensers, etc. — must be accurately related to one set of base lines.

Rails for 120-ton overhead bridge crane 97'6" apart must be truly parallel within 1/16" and set accurately at required distance.

Berger Instruments were on the job here, as they are on so many other Stone & Webster projects. For when the "specs" call for really close-tolerance construction, leading engineers and construction men buy Berger . . . Take one into the field and see why. *Count on quick delivery—thanks to enlarged capacity.*

C. L. Berger & Sons, Inc., 37 Williams Street, Boston 19

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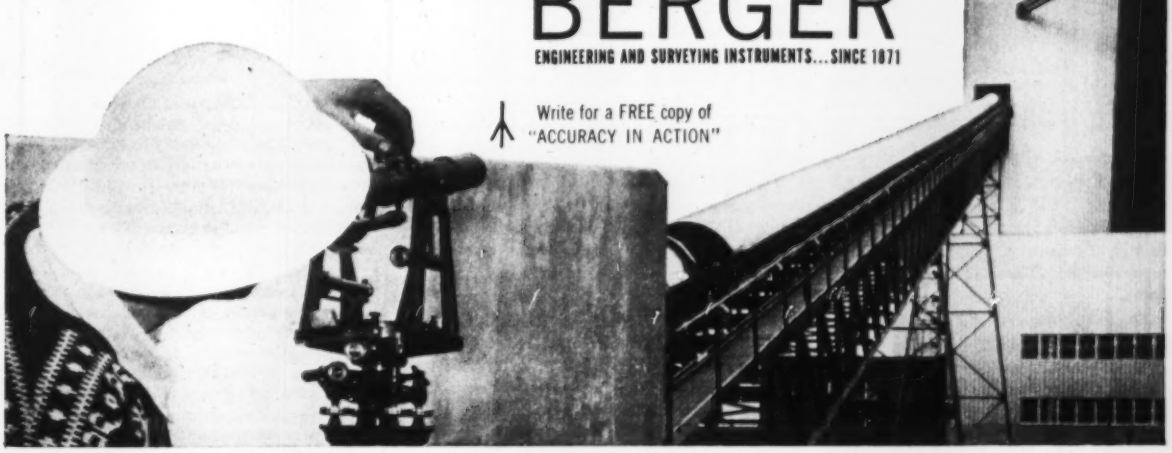


NEWS BRIEFS . . .

Committee to Advise on President's Road Program

To implement his $50 billion, ten-year highway plan, President Eisenhower has appointed a special advisory committee, which is headed by Gen. Lucius D. Clay, Hon. M. ASCE, retired lieutenant general, U.S. Army, and now chairman of the board of the Continental Can Co. The committee also includes Stephen D. Bechtel, M. ASCE, San Francisco construction executive; David Beck, president of the AFL International Brotherhood of Teamsters; S. Sloan Colt, president of the Bankers Trust Co., New York City; and William A. Roberts, president of the Allis-Chalmers Manufacturing Co., Milwaukee.

The President's committee will serve in a coordinating capacity, working with the special seven-member road committee of the Governors' Conference; the President's special Cabinet Committee on Transportation Policy and Reorganization; the Bureau of Public Roads; the Bureau of the Budget and congressional leaders. It will be expected to study recommendations supplied by federal agencies, the governors, and private organizations with a view to aiding the President in making his recommendations to Congress for an expanded program of highway building.

World Bank Loan to Rebuild Mexico Rail Line

The Pacific Railroad of Mexico (Ferrocarril del Pacifico) will be rehabilitated under the terms of a recent $61,000,000 World Bank loan to the company, which is guaranteed by the Mexican government. The loan will be used to finance an extensive modernization program, which will cost about $80,000,000 and require four years for completion. Rehabilitation of the line, which runs down the west coast of Mexico from the Arizona border to Guadalajara, will be based on a survey made by the New York consulting firm of Coverdale & Colpitts. The program includes re-laying most of the 1,200 miles of track, replacing steam with diesel locomotives, the purchase and repair of freight cars, and modernizing the communications system. Coverdale & Colpitts have been retained by the railroad to aid in carrying out the program.

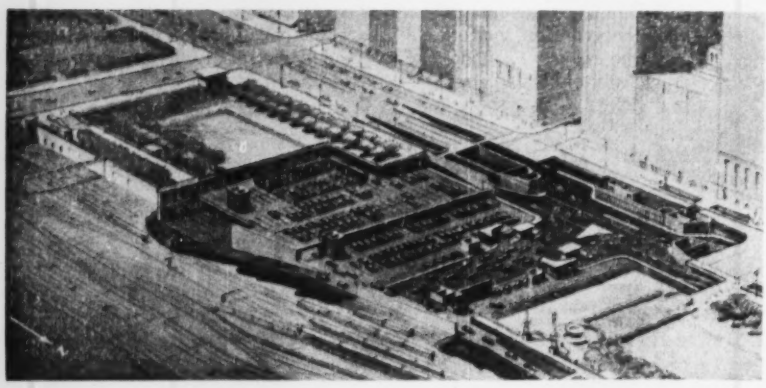
Built early in the century, the line was originally owned by the Southern Pacific Co., a United States system. It was sold to the Mexican government in 1951.

Army Engineers to Oversee St. Lawrence Seaway Work

Selection of the Army Corps of Engineers to aid in the construction of the United States portion of the St. Lawrence Seaway Project is announced by Lewis G. Castle, administrator of the St. Lawrence Seaway Development Corp. The services performed by the Corps of Engineers will include land acquisition; the preparation of engineering plans and specifications; making recommendations and rendering assistance in awards to bidders; and supervising such construction operations as the St. Lawrence Seaway Development Corp. may delegate to the Army.

Before accepting President Eisenhower's appointment as director of the St. Lawrence Seaway Development Corp., Mr. Castle was a Duluth banker. The deputy administrator of the corporation is Martin W. Oettershagen, engineer and manager of the Chicago port.

Chicago Opens Huge Underground Garage



With opening of its new Grant Park Underground Garage on September 1, the City of Chicago attempts to meet the pressing need for offstreet parking facilities in the congested Loop area. The garage runs under the part of Grant Park bordering on Michigan Avenue from Randolph Street to Monroe Street, a distance of three blocks. Said to be the world's largest underground parking project, the structure contains two floors and a mezzanine level and has an area of about 873,000 sq ft with parking capacity for 2,359 cars. Walls, floors, and columns are constructed of reinforced concrete. There is a plenum chamber above the upper level of the garage, the roof of which is being used as the Michigan Avenue roadway. The portion of the garage under Grant Park is being covered with 4 ft of soil to permit plant growth and the restoration of the park to its original state. The Chicago consulting firm of Ralph H. Burke, Inc., designed the project and supervised its construction, and the John Griffith & Son Construction Co. was the builder on a bid of $6,539,539. The project is owned and operated by the Chicago Park District.

Erie, Pa., to Enlarge Its Treatment Plant

Plans for doubling the capacity of the Erie, Pa., sewage treatment plant through additions and alterations have been made public in the terms of a contract between the Erie Sewer Authority and the constructor, the Rust Engineering Co., of Pittsburgh. Approximate cost of the project will be $3,780,000.

The project calls for converting the city's present primary-type plant, with a nominal capacity of 22.5 mgd, to a modified aeration-type unit having a nominal capacity of 45 mgd. It also includes construction of a small ejector station with a capacity of 100 gpm. Work is under way, and the entire project is scheduled for completion in the spring of 1956.

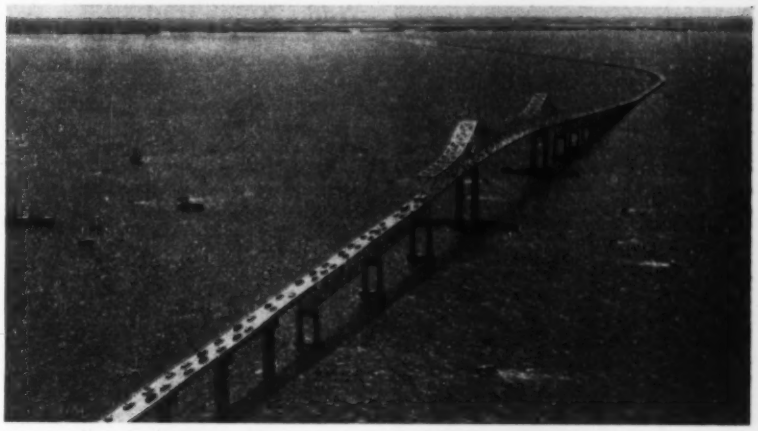
Italy Plans Five-Year Expressway Program

The Italian government has approved a five-year $400,000,000 program for building 1,100 miles of modern expressways. In addition, $3,200,000 has been provided for each of the next ten years for roadbuilding in southern Italy and $4,800,000 for improving secondary roads in the provinces.

A major feature of the expressway program will be construction of a turnpike from Milan to Rome and Naples. It is estimated that driving time between Milan and Naples will be cut in half by the proposed road, which will also unify the industry of north and south Italy and develop numerous contiguous areas. The expressway will have four lanes divided by a center median, and will provide for carrying all cross traffic over or under the route. Three big Italian companies—Agip, Fiat, and Pirelli—are working on construction plans.

Priority will also be given to roads from Milan to Seravalle and from Brescia to Padua which, with existing roads, will provide a continuous link across northern Italy between Genoa and Venice. Plans also call for doubling existing expressways between Milan and Turin, Naples and Pompeii, Milan and Bergamo and Florence to the seas. Construction costs are estimated at $500,000 a mile.

Tampa Bay Bridge Is Opened to Traffic



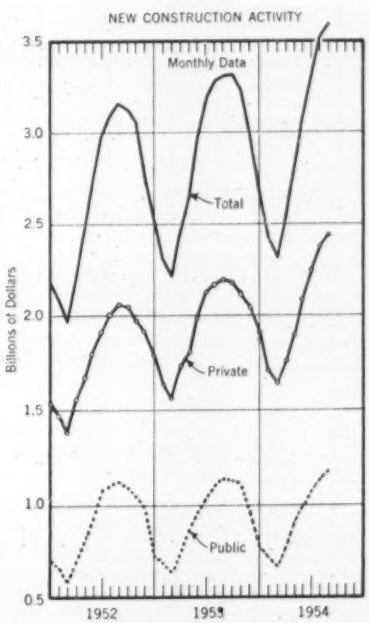
A fifteen-mile chain of causeways and bridges, spanning lower Tampa Bay, was opened to traffic on September 6 with an impressive motorcade and ceremonies headed by two governors. Called the Sunshine Skyway, the $22,250,000 span connects St. Petersburg directly with lower west Florida coastal cities and with the Everglades National Park and is the final link in the 500-mile Gulf Coast Highway running from Pensacola to St. Petersburg. The project is built in eleven sections—six hydraulic fills and five bridges (the longest the 4.23-mile center section). The structure is said to be the longest built to date with prestressed concrete. Parsons, Brinckerhoff, Hall and Macdonald were the engineers in charge of design and construction, and the American Bridge Division of U.S. Steel built the high-level steel section of the center span. Construction features of the project were outlined in articles in the April 1952 and January 1953 issues.

August Construction Activity Sets New Record

Expenditures for new construction rose seasonally in August to a record $3.6 billion, according to preliminary estimates issued jointly by the Departments of Labor and Commerce. August was the second successive month in which construction activity reached an all-time high. The annual rate of spending on new construction for the first eight months of 1954 (seasonally adjusted) exceeded $36.5 billion, compared with the record total of $35.25 billion actually spent in 1953.

Most of the July-August increase (3 percent) resulted from expansion in private residential building, public utility construction, and highway work. Outlays for almost all other types of construction remained at about their high July levels or rose slightly. A 2 percent decline in store building was less than usual for the time of year.

The dollar volume of new construction for the first eight months of 1954 reached $23.7 billion—a new record for the January-August period, even after adjustment for price changes. Private outlays were 5 percent higher for the period this year than last. Although expenditures declined for private industrial, railroad, and farm construction, these decreases were more than compensated by substantial gains in most other types of private work, including an especially sharp upswing of 30 percent on commercial building.



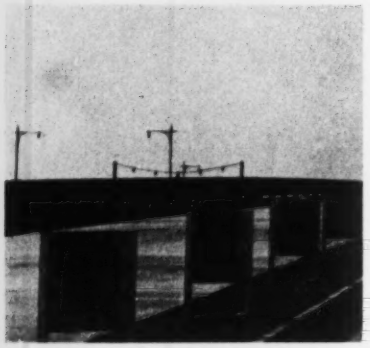
In August, for the second successive month, construction activity reached an all-time high, as shown by Department of Commerce curves. The August estimate of $3.6 billion represents a 3 percent increase.

Public outlays for new construction under way during the first eight months of 1954 were about the same as in the corresponding 1953 period. Declines in federal construction, especially on military facilities, were offset by increased state and local government outlays, mainly for schools, roads, and sewer and water systems.

So far this year more than twice as much has been spent for private as for public construction—$16.3 billion compared with $7.4 billion—and expenditures for private new housing alone ($7.3 billion) were almost as great as for all public construction together.

Anti-Glare Panels on Raritan River Bridge

A test installation of panels designed to eliminate headlight glare has been made on a 500-ft length of the center mall of the new 4,400-ft Raritan River Bridge on the Garden State Parkway in New Jersey. The anti-glare unit consists of an 18-in.-wide, glass-fiber reinforced plastic panel



mounted vertically between 2-in. square aluminum posts. The top of the panel is placed 4½ ft above the roadway and the panel set at an angle of 60 deg with the curb. Units are spaced 10 ft apart. If reaction to the panels continues favorable, they will be installed over the entire length of the bridge.

The desirability of an anti-glare barrier was suggested by H. W. Giffin, M. ASCE, chief engineer of the New Jersey Highway Authority. The design was developed by C. H. Gronquist, M. ASCE, associate engineer with the D. B. Steinman firm (designer of the bridge), in cooperation with the Winner Manufacturing Co., of Trenton, N.J., which is the manufacturer of the units.

New Army Civil Works Authorized

New congressional authorizations for the Civil Works Program of the Army Corps of Engineers are announced by Maj. Gen. Samuel D. Sturgis, Jr., Chief of Engineers. The authorizations, which have been signed by the President, are for the construction of 165 individual projects in forty states, Alaska, and Hawaii, with estimated total federal constructions costs of $638,851,814, and for seven river basin projects totaling $413,500,000. Broken down, there will be 102 river and harbor projects; 41 flood control projects; and 22 beach erosion control projects.

One of the largest project appropriations is $101,000,000 for extending the Inland Waterway from the mouth of the Delaware River to Chesapeake Bay. Basin authorizations include $180,000,000 for the Columbia River and $144,000,000 for the Missouri River.

Brick and Tile Industry To Have Research Center

The brick and tile industry will build a national research center to house its development efforts. According to an announcement from Robert B. Taylor, director of the Structural Clay Products Research Foundation, the group has voted to construct the center in the Chicago area where it will serve as a general headquarters for the organization and house most of the research projects being conducted.

Formed in January 1950, the Structural Clay Products Research Foundation has invested more than a million and a half dollars in efforts to lower the cost and improve the quality of structures built of brick and tile products. Its findings announced to date include the development of the "SCR brick," a through-the-wall unit especially designed for home construction; the "SCR" insulated cavity wall; and the evaluation and development of equipment to facilitate the use of clay products in masonry walls.

Housing Starts Continue At Near Record Levels

Though non-farm housing starts declined by 7 percent in July to 112,000, following a sharp counter-seasonal rise in June, the number of dwelling units put under construction was 16 percent above the figure for July 1953, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. The number was also substantially greater than in any other July on record, except for July 1950. Thus, for the first time in 1954, the cumulative number of dwelling units started since the beginning of the year topped the comparable record for 1953—683,500 units compared with 678,100.

Of the four broad regions of the country, the North Central showed the sharpest spring upturn in activity. In the four-month period from January through April (the last month for which complete geographic detail is available), the South accounted for the greatest number of new units started (30 percent), with the West and North Central regions accounting for 25 percent each, and the Northeast 20 percent.

Something New on Wheels

Called the Rhino, this revolutionary vehicle is said to outperform tanks, tractors, and other heavy-going units. The five-ton prototype model has a watertight body and 6-ft-high tilted hemispheroidal wheels that facilitate travel through mud, sand, swamps, snow, and water. On highways it goes at passenger-car speeds. When cruising in deep water, the driver shifts to a Hydro-jet unit for propulsion and steering. The tilted hemispheroidal wheels provide variable contact with the terrain. For highway use, only a narrow rubber tread of the tilted wheels touches the road. When mud and other soft areas are encountered, the natural sinking of the hemispheroidal wheels greatly increases the traction area with every inch of sinkage. The Rhino climbs 65 percent grades, although powered in the prototype with a Ford industrial engine of only 110 hp. Highway speed is 45 mph. Uses suggested for the Rhino by its inventor, Elie P. Aghnides, include petroleum prospecting; heavy construction projects; many agricultural and lumbering applications; and service as a marsh buggy.

Southern California Water Supply Condition Critical

Streamflow in Southern California in 1953 was again below normal, according to a recent review of water-supply conditions made available by the U.S. Geological Survey. Runoff from fourteen selected streams averaged 32 percent of normal. The report notes that in the area both precipitation and runoff follow a cyclic pattern of alternating wet and dry periods, which varies in both time and amplitude. The below-normal year of 1952–1953 indicates that the area is still in the "dry period," which started in 1944.

Storage in surface reservoirs, which was about 25 percent of total capacity at the beginning of the year, was found to have decreased to about 15 percent at the close of the year. In areas such as Antelope Valley, the San Jacinto Basin, San Luis Rey River Basin, West Coastal Basin, and others, the water level in observation wells is the lowest during the period of record. The ground-water levels are below sea level in some of the coastal areas, with local water supplies in these areas subject to contamination by salt-water intrusion. To supplement local supplies, water is being imported in ever-increasing amounts. Water importations into the coastal area from Owens Valley and the Colorado River came to a record high of 548,000 acre-ft in 1952–1953.

Copies of the report, which was prepared by the Los Angeles office of the Water Resources Division of the Geological Survey, may be obtained from the Survey, 429 United States Post Office and Court House, Los Angeles 12, Calif.

Fort Belvoir to Have Package Power Reactor

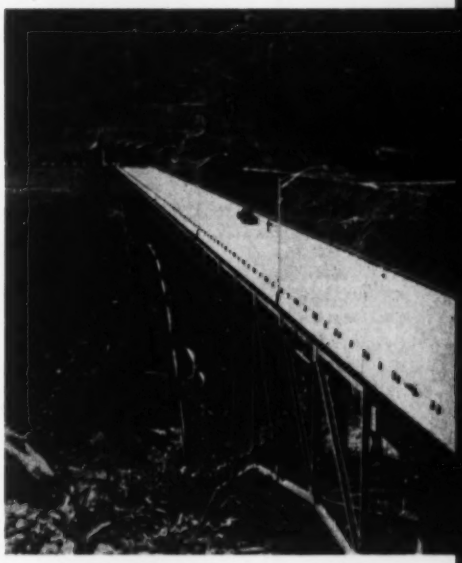
Fort Belvoir, Va., has been chosen as the site for a small, experimental, but full-scale, nuclear power plant, to be designed and built jointly by the Army Corps of Engineers and the Atomic Energy Commission. The plant is the prototype of a "package" or transportable power reactor, which is being developed for use at remote bases, eliminating the need to transport bulky conventional fuels. Location of the plant at Fort Belvoir will also provide a training facility that can be used in the regular program of the Army Engineer School there.

The reactor, which is of the pressurized-water type, will be built within the exclusion area of the Engineer Research and Development Laboratories, with full regard to the safety of nearby communities. It will be built of materials transportable by air, and will have a capacity of approximately 1,700 kw. Succeeding plants for remote bases are expected to produce heat for space heating in addition to electricity.

West Virginia Turnpike Is Opened to Traffic

Dedication of the West Virginia Turnpike, an 88-mile limited-access highway running from Charleston, W. Va., southeast to Princeton, W. Va., took place on September 2 at Princeton following a motor trip over the route. Begun in 1952, the project replaces a tortuous 107-mile road with 9 percent grades and curves of 50-ft radius. A unique feature of the turnpike is that, although conceived as a four-lane divided highway, it was built in a preliminary stage generally two lanes wide. Cost of the project was $133,000,000.

Final design and supervision of construction were handled by Howard, Needles, Tammen & Bergendoff as general consultants. Other engineering firms engaged on the project were Singstad & Baillie; the Capitol Engineering Corp.; Fay, Spofford & Thorndike; and Gannett Fleming Corddry & Carpenter, Inc. Construction of the project was discussed in an article in the February 1954 issue.



Fourmile Fork Bridge is an important engineering project on the turnpike route. It is 278 ft high and 1,230 ft long.

Installation Standards for Construction Work—A New Approach to Avoiding Jurisdictional Disputes

GEORGE F. HUSSEY, JR., Vice-Admiral, USN (Ret.)
Managing Director, American Standards Association, Inc.

A new development of particular interest to civil engineers is the increasing use of national installation standards as a means of avoiding jurisdictional labor disputes. It represents a new phase of standards work and a new approach to a serious labor-management problem that deserves discussion at this time.

Today standards are generally recognized as the basis of all modern production methods. The American economy is built around standards of dimension, definition, performance, testing and safety. Some of these are simply standards of long custom and habit. Some are consciously created company standards. Others are trade association and technical society standards that have an industry-wide or national use. About 1,430 standards are American Standards, which means that they are nationally accepted.

The American Standards Association (ASA) lists 182 American Standards for civil engineering and construction, ranging from Specifications for Portland Cement (A 1.1-1950) to Specifications for Facing Brick—Solid Masonry Units Made from Clay or Shale (A99.1-1953). Most of these standards cover products and materials only. There are few national standards for installation procedures, though in the construction field the methods and quality of installation work are of major importance.

In these installation standards there exists the possibility for reducing or eliminating jurisdictional labor disputes. Such a dispute normally concerns a disagreement between two or more of the twenty craft unions employed in construction activities, as to the nature of the material being installed and the methods of installing it. Where such a dispute is settled locally, the settlement may hold only for the one job or building concerned. A similar dispute could arise on an other job in the same neighborhood. Such a settlement may not be based on national standards, and it does not set a precedent for city or nation.

The American Federation of Labor, through its National Board of Jurisdictional Awards, provides a well-tested piece of machinery for settlement of jurisdictional disputes among the building and construction trades. Many cases reaching the board, however, might never have arisen if generally recognized installation standards had existed.

Of the fifteen American Standards that provide specifications for installation of various other materials, seven are concerned with the installation of different types of flooring, such as general-purpose,

heavy-duty, oxychloride, and other composition flooring. Four specifications cover various types of plastering, stucco, lathing, and furring work. Others concern excavation and foundation work and the design, fabrication, and erection of structural steel. The American Standard Specifications for Gypsum Plastering (A 42.1-1950) has been exceptionally successful. More than 30,000 copies were distributed within the first few months of its publication.

As current standards are revised, greater attention is being paid to installation details. Under ASA project A 59, "American Standards Building Code Requirements for Reinforced Gypsum Concrete, A 59.1-1945" is now being revised. Specifications for application will be included in the revision. Two labor unions are participating in the project.

The New York Building Congress (a group of architects, contractors, engineers and others interested in the construction industry) has made a number of informal recommendations to the American Standards Association for establishing installation standards, including specifications for concrete framing, interior stairs, thermal insulating materials, heating and refrigerating, and various types of resilient flooring. The ultimate goal is national installation standards for the whole construction industry. Most interested persons agree that this goal may be a long way off, but they all feel that it represents one of the basic needs of the industry, and that sooner or later it is certain to be attained.

Among the objectives of installation standards are: (1) to establish the nature of the material; (2) to specify quality and dimensions of the material; (3) to lay down installation procedures; and (4) to establish a quality standard of installation work. Such overall specification should be presented in a form that allows the architect to make ready reference to it in his own specifications and that is thoroughly understood by the builder, the subcontractor, and the foreman on the job. Above all, it should be recognized by labor as a fair job description, which leaves no doubt as to who should do the job.

One of the most important principles of ASA is voluntary cooperation. To make a standard a success, every group substantially concerned with it—and labor is an important factor in installation standards— is invited to participate in the development of the standard. Standards are not adopted by simple majority vote, but rather by the consensus principle. Every effort is made to thresh matters out so thoroughly that a decision which is unanimous or nearly so can be reached.

The ASA is a service organization for associations and societies that are interested in developing and coordinating national and international standards. Its present membership comprises 114 national trade associations, technical societies and group organizations, in addition to about 2,300 company members. ASA is the recognized American channel for participation in international standardization matters. ASA was founded in 1918 by five major engineering societies.

Aluminum Industry Sets New Production Record

A new quarterly production high of 732, 515, 499 lb climaxed the record-breaking pace set by the United States aluminum industry during the first half of 1954, according to Donald M. White, secretary of the Aluminum Association. New monthly records were set in January, March, and May. Primary production in the first half of the year was almost 20 percent over the 1,198,407,109 lb produced in the same period of 1953 and almost as much as the total production in 1950.

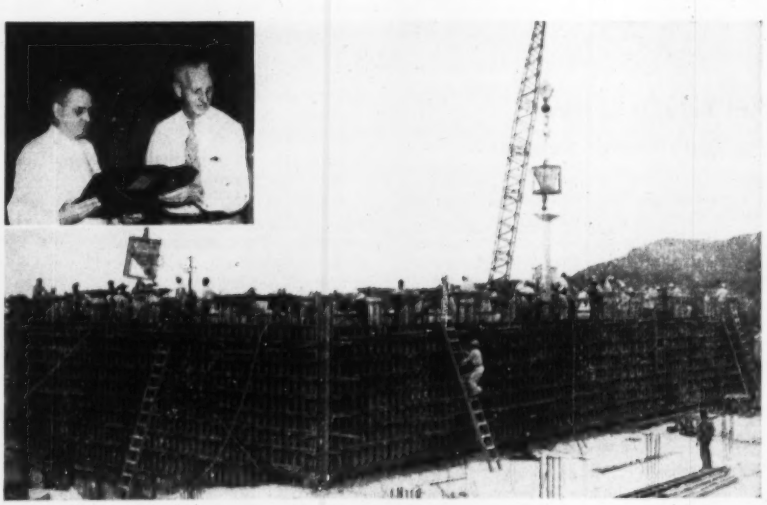
Coming months are likely to see further increases in primary production, Mr. White predicted. Capacity operation of new equipment not yet in full commercial production is expected to set new records in the second half of the year. As a result of the availability of more aluminum for civilian uses, new uses for the metal in both new and established fields are developing almost daily. Some of the most spectacular developments in application of the metal are taking place in the building field, Mr. White said, citing a new building at 460 Park Avenue, New York, as an example. The two street-side walls of the seventeen-story structure were completely covered with prefabricated aluminum panels in only one working day.

Safety Record Set on Guam Construction Job

National Safety Council laurels were recently awarded to Brown-Pacific-Maxon, co-venturers on a construction contract in Guam on installations for the Navy, Air Force, and other government agencies. On the contract, which was administered by the Bureau of Yards and Docks under the supervision of Comdr. N. M. Martinsen, of the Civil Engineer Corps, there was established a construction safety record that is receiving national recognition. The co-venture group was made up of Brown & Root, Inc., the Pacific Bridge Co., the Maxon Construction Co., Inc., the Swinerton & Malberg Co., and the Utah Construction Co.

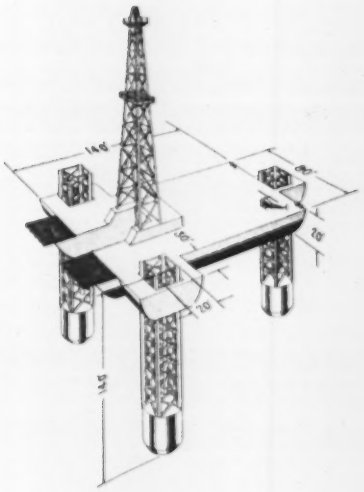
Operations started in August 1946. In the ensuing contract period, there have been some 30,200 employees—15,000 Americans and 15,200 Filipinos. This personnel has been used in nearly every trade skill common to a construction program covering a wide variety of facilities, such as roads, electrical transmission lines, water and sewage facilities, electronic installations, runways, hangars, repair shops, barracks, housing and administrative structures, and all the installations required to operate these facilities.

During the past four years, the average work force has been 1,000 American and 4,500 Filipino employees. Many of these



Safety record on construction of Guam Naval Hospital was one of top performances on the island. Job required 1,803,704 manhours during final twelve months of project and achieved a frequency rate of 1.1 and a severity rate of .05—only 90 days accumulated time lost by a total of 800 men for an entire year. Insert shows J. Russell Marshall (left), project manager for the contractor, receiving the National Safety Council's highest safety award from Fred Braun, a director of the Council and vice-president in charge of accident prevention for the Employers Mutual Insurance Co.

Offshore Drilling Platform Developed for Tidelands Oil Prospecting



Construction work on this huge three-legged, ocean-going drilling platform—designed by R. G. Le Tourneau, Inc.—will soon be started at the company's Vicksburg, Miss., plant and is scheduled for completion in early 1955. Designed to meet oil producers' needs for mobility, speed, and reduced costs in exploring the Gulf tidelands, the platform is of all-welded steel construction and features electromechanically controlled legs called spuds, which are raised or lowered through wells located at three outboard points around the platform. The spuds make it possible to keep the platform level in spite of variations in the level of the ocean floor. They are of open framework design, strongly braced but offering minimum resistance to ocean waves and currents. Cylindrical-shaped tanks at the bottoms of the spuds add buoyancy when the ocean bottom is soft. The platform itself is a self-contained unit with barge compartments for equipment and drilling supplies. The Zapata Petroleum Corp. has taken an option on purchase of this first unit at a reputed price of $2,000,000.

employees had to travel over 7,000 miles to the work site, which meant adjusting family and domestic ties. It was the first time on Guam that Americans and Filipinos had worked side by side, and the language difference necessitated developing uniform work habits and new standards of safety. The workers came from all walks of life. Their education, in many instances, was limited. In addition, the actual job sites were likely to be treacherous—dense jungles or coral formations—and many of the work areas contained live ammunition. The American employees were in unfamiliar surroundings and subject to the ever-present dangers of severe sunburn, heat exhaustion, fungus and other infections, to mention a few of the hazards of life in the tropics.

In spite of the various problems and potential dangers a sound working organization was built up, and from July 1948 to July 1954 there was amassed the amazing total of 67,275,000 manhours worked. During this six-year period there were relatively few serious accidents and only one fatality. There were seven minor accidents from dynamite or war relics; 74 accidents attributable to the handling of electrical facilities; 58 minor accidents from gas fumes; and 590 accidents caused by falls from elevated structures. In all these various types of accidents, only 8,295 man-days were lost.

Through the diligent efforts of the safety staff and with the assistance of the insurance carrier's representatives, the accident-frequency rate steadily declined to the present low of 3.87 per million manhours worked—four times less than the national average of 17. As a result of this accelerated safety program the insurance carriers have reduced the premium by approximately two-thirds.

Nuclear Notes

VI—Natural Radioactivity (Part 2)

"Nuclear Notes" are prepared for the Sanitary Engineering Division by its Committee on Sanitary Engineering Aspects of Nuclear Energy. Conrad P. Straub, of the Oak Ridge National Laboratory, heads the committee, which also includes S. T. Barker, A. E. Gorman, Prof. Warren J. Kaufman, and James G. Terrill, Jr. Next month's subject will be: "Artificial Radioactivity."

In the last column we learned that there are about 40 naturally occurring radioactive isotopes. These materials give off ionizing radiations which can be measured by means of suitable techniques. The activity—disintegrations—is reported in terms of the curie (c), which was originally defined as the amount of radon in equilibrium with 1 gram of radium. At the present time, the curie is defined as the quantity of any radioactive material giving 3.70×10^{10} disintegrations per second (dis/sec). One-thousandth of one curie is known as the millicurie (mc) and represents 3.70×10^{7} dis/sec; one-millionth of one curie is known as the microcurie (μc) and represents 3.70×10^{4} dis/sec.

In addition to the activity found in naturally occurring radioelements, the earth is being bombarded continuously by radiation (thought to be high energy protons) originating in space. This radiation, in passing through the atmosphere, produces a multitude of other types of radiation such as electrons and protons. Such a complex mixture of radiations is known as cosmic radiation or cosmic rays. Cowan[1] reports that in the northern portion of the eastern United States there is about one cosmic-ray particle per square centimeter per minute, which increases to five times this value at an elevation of 15,000 ft and to 75 times this value at about 55,000 ft where the maximum intensity is found*. Cosmic radiation accounts for about 70 percent of the background count at sea level.

It is of some interest to note that natural radioactive materials such as uranium, thorium, and radium are very widely distributed in the earth's outer crust. Average figures have been given[1] as follows: uranium 6 ppm, thorium 12 ppm, and radium 2×10^{-6} ppm by weight.

Among the decay products of uranium and thorium are two radioactive gases, radon and thoron, which will always be found in small concentration in the air. Radon concentrations in the air are reported[1] to be of the order of 10^{10} μc/cc, or about 6 dis/min/cu ft of air. Thoron concentrations amount to only a few percent of the radon concentrations. The decay products of these gases are solids and, for the most part, attach themselves to dust particles in the air. Rain will wash down some of the air activity, and thus may increase the surface contamination at the expense of the airborne contamination.

Owing to the fact that the rain has fallen through air and/or filtered through the soil, drinking water contains radioactivity primarily as uranium, radium, and radon. Concentrations as small as 10^{-9} to 10^{-10} μc/cc are common in the case of uranium and radium, although values up to 1,000 or more times these concentrations are known in some mineral springs. The

concentration of radon behaves similarly, but may be considerably larger than that of uranium or radium. An interesting study recently published by Hursh[2] lists the radium and radon contents of 41 public water supplies in this country. In sea water the amount of K^{40} is about 3×10^{17} μ/cc, and it is reported[1] that the oceans contain about 5×10^{11} curies of this element. It is reported also that cow's milk may have an activity as high as 6×10^{-8} μc/cc due to the K^{40} present.

About 50 percent of the total gamma-ray background at the surface of the earth is due to cosmic radiation; the remainder is due to the radioactive materials in the air, the ground, and the materials from which buildings and apparatus are constructed. Thick lead shields are used to reduce the background counts for low-level laboratory detection instruments. By this means background counts are reduced by a factor of 2 or 3 but are not eliminated completely. In reporting actual counts the background count is subtracted from the sample count.

A paper[3] containing information on the release of radon from aggregate materials used in concrete has recently come to the attention of this committee. This paper reports the results of a study to determine the increase in release of radon from fissures in the aggregate as a result of radiant heating of the walls or floors built with aggregates containing small amounts of natural uranium. It was found that increased amounts of radon (a radioactive gas and the daughter of natural radium or great-granddaughter of uranium) diffused from concrete annuli because of the increase in pore size or fissures as a result of increased temperatures. If the uranium content of these low-grade aggregate materials exceeds 0.004 percent they should be avoided in the construction of dwellings for human habitation. The amount of activity given off is considered detrimental to humans although such aggregates may be used in the construction of structures that are not for human habitation. In the study cited it was found that radiant heating, due to an opening of aggregate microfissures, effected a 20 percent increase in the total activity released from the aggregate, as compared with the total activity released during normal processes of decay at ambient temperatures. It is believed that additional studies of this nature would be of value in determining the specific hazards relating to the use of low-level natural radioactive materials.

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[1] Cowan, Frederick P. *Quantitative Summary of Natural Radiation and Naturally Occurring Isotopes.* ARCU-1138. Brookhaven National Laboratory (January 4, 1951).

[2] Hursh, John B. "Radium Content of Public Water Supplies." *J. Am. Water Works Assn.*, 46:1, 43–54 (January 1954).

[3] Gabrysh, A. F., and F. J. Davis. "Radon Released from Concrete in Radiant Heating." Oak Ridge National Laboratory, Oak Ridge, Tennessee. In press. *Nucleonics* (1954).

[4] See also E. O. Wollan's discussion of cosmic rays in *Medical Physics.* Edited by Otto Glasser. The Year Book Publishers, Inc., Chicago, Ill. (1944), pp. 284–286. Also the references indicated by Wollan.

N.G.Near's * COLUMN

R. ROBINSON ROWE, M. ASCE

"What luck," asked the Professor, "did you have with the registration examination."

"If you're asking me," confessed Joe Kerr, "I flunked for the ninth time. My fault, tho, for daydreaming on the fifth problem that asked for explanations of 15 terms like 'tell-tale,' 'dapped joint,' 'upset bar' and 'jinny-wink.' I started dreaming of the tall tale of Dan McGrew's boys a-whooping it up. I saw the mounties dap the joint after the bar was upset and watched the boys locked up in the jinny-wink. Then just at midnight a strange voice said, 'Five o'clock, gentlemen; hand in your papers' and I woke up thoroly flunked."

"You're daydreaming again. I was asking if you had worked my August problem about a registration examination."

"I'm awake and I've worked it," bragged Cal Klater. "It was a problem in normal distribution of small numbers, which I'll explain for Joe's benefit. It means that distribution of grades for each problem was proportional to binomial coefficients, that is, to the coefficients of the expansion of $(1+x)^n$. For the first problem, $n=6$ and the expansion is:

$$1 + 6x + 15x^2 + 20x^3 + 15x^4 + 6x^5 + x^6.$$

Symbolically, this means that for every man who scored 6 points, 6 scored 5 points, 15 scored 4, etc., according to the relation of coefficient to exponent of each term. The sum of all coefficients is 64 $(=2^n)$. Since the last three add to 22, then 22/64 of the men scored 4 or better. Now you told us that 176 men scored 4 or better, so there must have been 512 who took the examination.

"On the second problem, with a weight of 8, you said 186 were graded 5 or better. For $n=8$, the coefficients are $1+8+28+56+70+56+28+8+1 = 256$ and the last 4 add to 93. Again $93/256 = 186/512$, checking the 512 nicely.

"The third problem was the gimmick, for it was an 11-pointer on which 130 scored 7 or better. But if $n=11$, we would to have $2^{11} = 2{,}048$ men, and we have only $512 = 2^9$. For $n=9$, the 4 last coefficients $(84+36+9+1)$ add to 130, so there was a normal distribution of scores 1 to 10 and no one scored 0 or 11. Then tabulating the 3 distributions:

Score	Problem 1	2	3
0	8	2	0
1	48	16	1
2	120	56	9
3	160	112	36
4	120	140	84
5	48	112	126
6	8	56	126
7		16	84
8		2	36
9			9
10			1
11			0

"Finally you asked how many passed with a total of 16 or better out of 25. Well there are 161 combinations of scores from 16 to 24, for each of which the probabilities can be computed like $48/512 \times 56/512 \times 126/512$, so real drudgery led to a passing probability of 0.105, and 54 of the 512 should have passed."

"Right, but there needn't have been any drudgery. The product of such distributions is still normal. For $n=23$ $(6+8+9)$, the last 9 coefficients add to 880970, which can be divided by 2^{23} to find the probability of 0.10502.

"Now for a bit of flotsam with smaller numbers. Floating 60 percent submerged in the ocean was a wooden wedge 3 ft long and isosceles in section. The two base corners of the section were respectively 4 in. above and 12 in. below the surface of the water. What did it weigh?"

[*Cal. Klaters were Richard Jenney, Rudolph W. Meyer, Stoop (John L.) Nagle and G. I. (Morton) Raff.*]

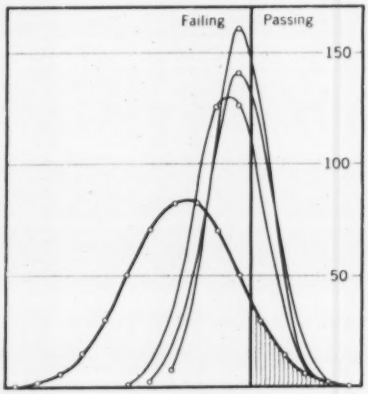

Fig. 1. Altho 25 to 36 percent passed each of the three problems (light curves), distribution of the combined scores (bold curve) disclosed that only 10.5 percent of the candidates (shaded area) passed the test.

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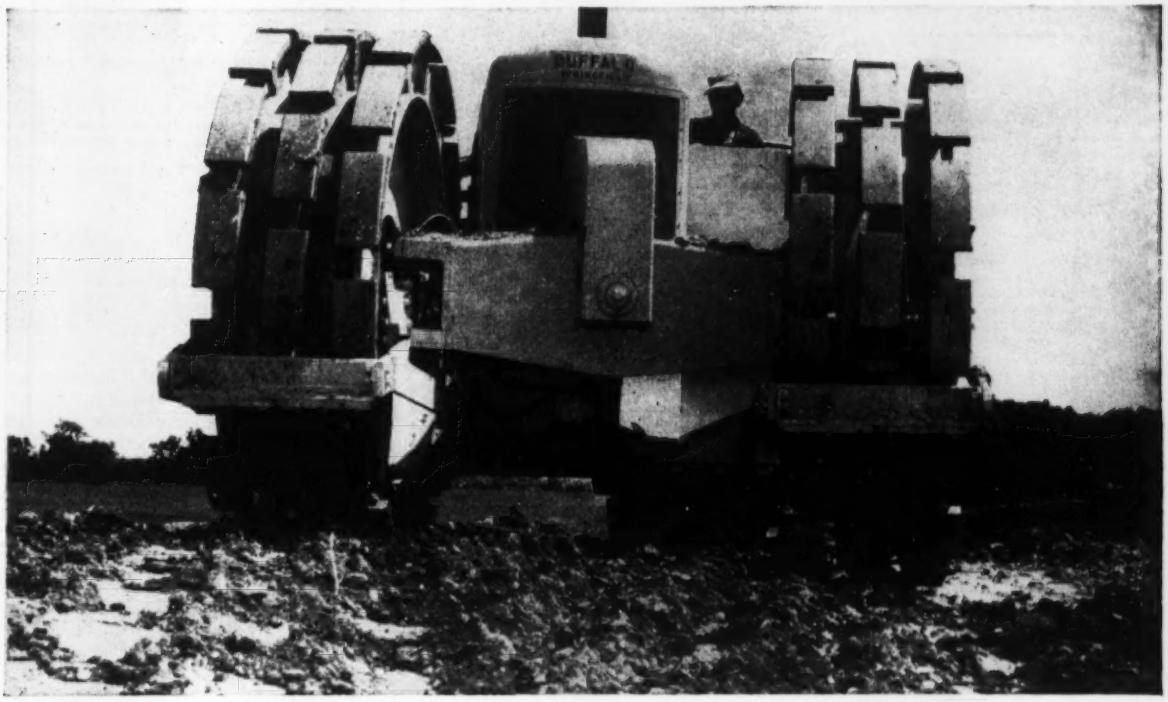

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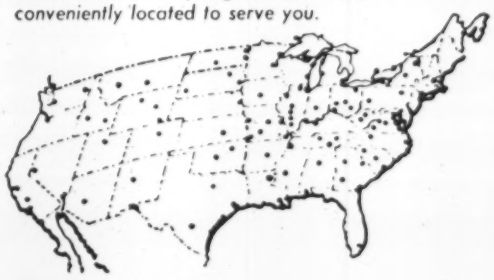

The unique rolls of the Kompactor are *segmented*. The staggered "islands" that form the rolling surface enter loose material with minimum displacement, either forward or horizontally. They leave without disturbing compacted areas in any way. All compaction effort is *downward*, resulting in greater and more uniform density from lower elevations to top surface. As a result, *two passes with the Kompactor will often meet density requirements!*

Before you bid another soil compaction job, find out more about the Buffalo-Springfield Kompactor. It may completely change your time and cost picture, give you a clear-cut advantage in bidding those close jobs!

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THE LEADER IN ROAD ROLLER DESIGN AND MANUFACTURE.

New Publications

Intracoastal Waterway Maps. Publication of the 1954 (sixth) edition of the Navigation Map Folio of the Intracoastal Waterway, Gulf Section, is announced by the Office of the President, Mississippi River Commission. Copies of this edition, which covers the Waterway from New Orleans, La., to Port Arthur, Tex., may be ordered from the Commission. The price is $1.

Nickel in Bridge Construction. The advantages of nickel steels and other nickel alloys in bridge construction are described in Bulletin A-179 of the International Nickel Company, Inc. Use of the higher-strength nickel steels makes it possible to design lighter sections to eliminate excess weight, lowering erection and freight costs. The high-strength low-alloy steels extend paint life from 20 to 50 percent, reducing maintenance costs. Examples of the use of other materials such as ductile iron, monel, nickel cast iron and cast nickel alloy steel are given. Copies of the 36-page illustrated booklet may be obtained from International Nickel, 67 Wall Street, New York 5, N.Y.

British Practice Code. Availability of a new Civil Engineering Code of Practice—Code No 4; Foundations—is announced by the Institution of Civil Engineers. Dealing with foundations for the normal range of buildings and engineering structures, the new code covers the general principles of design in relation to bearing and earth pressures; design and installation of the main types of foundation; site operation and construction procedures involved in foundation engineering; and discussion of the various materials used in foundations. The Canadian Standards Association, Ottawa, acts as sales agent for the code, which is priced at 15s, post free.

Parking Meters. A study of the use of parking meters in the United States and Alaska, based on a comprehensive questionnaire returned by 1,167 municipalities, is reported in Highway Research Bulletin 81. The study was a joint undertaking of the American Municipal Association, the Highway Research Board, and the Bureau of Public Roads. Copies, priced at $1.35, may be purchased from the Board, 2101 Constitution Avenue, Washington 25, D.C.

Resistance Strain Gages. Latest results, both experimental and theoretical, in a study of resistance strain gages made by leading institutions in the United States and abroad, are reported in National Bureau of Standards Circular 528. The 140-page publication, entitled *Characteristics and Applications of Resistance Strain Gages*, may be ordered from the Government Printing Office, Washington 25, D.C. The price is $1.50.

Subsoils Study. An investigation of engineering properties of Chicago subsoils—conducted by the Engineering Experiment Station at the University of Illinois in cooperation with the Western Society of Engineers and the Illinois Section of ASCE—is detailed in the Station's Bulletin No. 423. The authors are Ralph B. Peck, M. ASCE, research professor of civil engineering and William C. Reed, formerly research graduate professor of civil engineering. The bulletin is for sale by the Engineering Experiment Station, University of Illinois, Urbana, Ill., at $1 a copy.

Urban Problems. Ways of overcoming problems accompanying the rapid growth of municipalities are discussed in a recent publication of the Chamber of Commerce of the United States. Entitled *A Brighter Future for America's Cities*, the 150-page book records the proceedings of the two-day national Businessmen's Conference on Urban Problems, held in San Diego, Calif., in March 1954. Copies, priced at $1 each, may be ordered from the Chamber of Commerce of the United States, Washington 5, D.C.

News of Engineers

(*Continued from page 28*)

Carl Rohwer retired on July 1 as senior irrigation engineer in the Division of Irrigation of the Department of Agriculture after 40 years of service. For the past six years he was in charge of the division's research work being conducted at Fort Collins, Colo., in cooperation with Colorado A & M College and other agencies.

Wade Peebles, for the past two years, chief deputy city engineer of Englewood, Calif., has been advanced to the post of city engineer.

Raymond H. Miller, who has been with the Bangor & Aroostook Railroad since 1948, has been promoted from assistant engineer to principal assistant engineer.

Lyle E. Seeman, Colonel, Corps of Engineers, has been designated Southwestern Division Engineer, with headquarters at Dallas. Colonel Seeman will succeed Brig. Gen. Herbert D. Vogel, new chairman of the TVA (September issue, page 25). In World War II Colonel Seeman was assigned to the China-Burma-India Theater, and later served for two years with the Manhattan Engineer District. He was district engineer in Alaska from 1949 to 1952.

Vernon G. MacKenzie and **Albert H. Stevenson,** officer in charge and senior sanitary engineer for the Taft Sanitary Engineering Center at Cincinnati, have been transferred to the Public Health Service in Washington.

H. A. Saurbrey, vice-president of the Pittsburgh contracting engineering firm, Mellon-Stuart Co., was recently elected to the newly-created position of executive vice-president. Mr. Saurbrey joined Mellon-Stuart as vice-president in 1949. Previously he was associated with the Westinghouse Electric Corp.

Non-ASCE Meetings

American Concrete Pipe Association. The Association's fourth annual short course school of instruction will be held at the Statler Hotel, St. Louis, Mo., October 25-27. Exhibits of equipment used in the concrete pipe industry will be a feature. Details are available from the American Concrete Pipe Association, 228 North La Salle St., Chicago 1, Ill.

American Institute of Electrical Engineers. Fall general meeting at the Morrison Hotel, Chicago, Ill., October 11-15.

American Institute of Steel Construction. Thirty-second annual convention at the Greenbrier, White Sulphur Springs, W. Va., October 25-28. Further information from the American Institute of Steel Construction, 101 Park Ave., New York, N.Y.

American Welding Society. National fall meeting at the Sherman Hotel, Chicago, Ill., November 1-5. The National Metals Exposition will run concurrently at the International Amphitheater, Chicago. Further information from the American Welding Society, 33 West 39th St., New York 18, N.Y.

Engineers' Council for Professional Development. Twenty-second annual meeting at the Hotel Alms, Cincinnati, Ohio, October 28-29. Prof. Cornelius Wandmacher, University of Cincinnati, is general chairman.

Highway and Surveying Conference. The 1954 conference will meet on the University of Florida campus at Gainesville, October 21 and 22. For further information write to Prof. Thomas L. Bransford.

National Association of Corrosion Engineers. Fourth annual conference of the Western Region at the Hotel Biltmore, Los Angeles, November 18-19. A two-day meeting of the South Central Region will take place in Dallas, Tex., October 14-15.

National Conference on Industrial Hydraulics. Tenth annual meeting at the Sheraton Hotel, Chicago, October 14 and 15. Armour Research Foundation and the Illinois Institute of Technology are co-sponsors.

National Metal Congress & Exposition. Thirty-sixth national congress at the Palmer House and Morrison Hotel, Chicago, October 30-November 5. W. H. Eisenman, Secretary, ASM, 7301 Euclid Ave., Cleveland, Ohio.

National Safety Congress and Exposition. Forty-second National Safety Congress and Exposition, sponsored by the National Safety Council, 425 North Michigan Ave., Chicago, in the Conrad Hilton, Blackstone, Congress, La Salle, and Morrison hotels, and the Palmer House, Chicago, October 18-22.

Society of Automotive Engineers. National transportation meeting at the Sheraton Plaza Hotel, Boston, October 18-20. John A. C. Warner is Secretary of SAE, 29 W. 39th St., New York, N.Y.

Structural Clay Products Institute. The 1954 convention at the Hotel del Coronado, near San Diego, Calif., November 6-10.

Structural Engineers Association of California. The 1954 annual convention will be held at the Hotel del Coronado, San Diego, Calif., October 14-16. Contact Alfred E. Waters, vice-chairman of the publicity committee, 5168 Oakwood Avenue, La Canada, Calif., for further information.

Uses of Plastics in Building Conference. Co-sponsors of the conference, to be held at the National Academy of Sciences, Washington, D.C., October 27 and 28, are the Manufacturing Chemists' Association, the Society of the Plastics Industry, and the Building Research Advisory Board.

Here's the answer to your **road building** problems!

● Add advantages of asphalt road construction or resurfacing . . . quick laying, easy upkeep, long service, low cost . . . to the availability of Standard Oil asphalt. That's the answer to your road building problems.

With five asphalt-producing refineries located throughout the Midwest, Standard offers you savings in shipping time and costs. Call your local Standard Oil office.

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DECEASED

Robinson Abbott (A.M. '39), age 62, since 1945 head of the department of structural design and architecture at the Franklin Technical Institute, Boston, Mass., died on June 18. A 1918 graduate of Tufts College, he was an instructor and assistant professor there from 1919 to 1938; visiting professor at Bucknell University in 1938 and 1939; and a teacher in the evening session at Franklin Tech from 1922 to 1940. During the war Professor Abbott was with the U. S. Navy Bureau of Yards and Docks, and served as chief engineer for the U. S. Naval Air Stations at Bermuda and Atlantic City, N.J.

Don William Bingham (A.M. '19), age 65, for the past five years design engineer for the Huron-Clinton Metropolitan Authority, at Detroit, Mich., died in that city on May 4. A graduate of the University of Michigan, Mr. Bingham had been assistant city engineer of Saginaw and Traverse City, Mich.; sanitary engineer for the health departments of Lansing and Detroit; and an engineer for the U.S. Shipping Board, U.S. Public Health Service, and the Public Works Administration. From 1921 to 1933 he had a consulting practice in Flint, Mich.

Irving Clinton Brower (M. '16), age 75, retired engineer of Orlando, Fla., died on June 15. Mr. Brower had been city manager of Pontiac, Mich. (1921–1924); Lima, Ohio (1925–1930); Greensboro, N.C. (1931–1933); and New Rochelle, N.Y. (1935–1940). He was then with the Federal Works Administration in Washington, D.C., and the Federal Housing Authority, in Atlanta, Ga. In his early career he was in the engineering departments of several railroads. Mr. Brower graduated from Cornell University in 1901.

Philip Lee Bush (M. '16), age 78, consulting engineer of San Francisco, Calif., died at his home in that city on June 24. Mr. Bush had been associated with the California Packing Corp. (and its predecessor, the California Canners Association) continuously from 1897 to 1951. He received the bachelor of science degree from the University of California in 1896.

Harold Edgar Butcher (J.M. '48), age 29, associate engineer for the Carbide & Carbon Chemical Division of the Atomic Energy Commission at Oak Ridge, Tenn., died on June 10. Mr. Butcher received the civil engineering degree from the University of Tennessee in 1948. Following graduation he worked for Skidmore, Owings & Merrill on construction at Oak Ridge, and in 1950 became connected with the Atomic Energy Commission.

Francis Lee Castleman (M. '16), age 79, died on July 18 at Storrs, Conn., where he had been living since his retirement in 1946. On the staff of the American Bridge Co. from 1901 until his retirement, Mr. Castleman was in charge of engineering at the Pencoyd and Trenton plants. He was an alumnus of Lehigh University.

John Joseph Costa (A.M. '25), age 61, consulting structural engineer and dean of the lay faculty of Manhattan College, died at his home in Riverdale, N.Y., on July 14. Professor Costa graduated from Manhattan College in 1915 and was on the faculty of the school of engineering there for 37 years. Last year he was awarded a medal in recognition of his distinguished service to the college. Professor Costa was the author of several papers on various phases of civil engineering, and his latest work, *Structures*, was published in 1953.

Edward Hyatt (M. '24), age 65, former state engineer and chief of the Division of Water Resources of the California State Department of Public Works, Sacramento, died there on June 17. In state service from 1914 to 1950, Mr. Hyatt began his career with the California Highway Commission transferring in 1916 to the State Water Commission. In 1924 he was appointed chief of the Division of Water Rights and in 1927 state engineer—posts that he held until his retirement. Since his retirement he was acting as consultant for the Sacramento Valley Water Users Committee. He was one of the original petitioners for the formation of the Sacramento Section and second president of the Section in 1923. He was a graduate of Stanford University.

Edward Hyatt

Arthur Emmett Cowell (A.M. '15), age 77, civil engineer of Sonoma, Calif., died in that city on June 30. In 1902 Mr. Cowell became county surveyor for Merced County, California, resigning in 1922 to devote his full time to private practice. At various times he did work for the National Park Service in Utah and California.

Hugh Lindesay Crawford (M. '52), age 71, since 1928 engineer and manager of the Burley (Idaho) Irrigation District, was killed in an automobile accident near Burley on June 13. Following graduation from Washington State College in 1911, Mr. Crawford was with the U.S. Bureau of Reclamation at Sunnyside and Burley, as a surveyman and assistant engineer for 17 years.

William Smith Downs (M. '19), age 71, who retired a few months ago as professor of railway and highway engineering at West Virginia University after 23 years in the post, died recently. Early in his career, Professor Downs worked for the Morgantown & Kingwood Railway and the Hydroelectric Co. of West Virginia. Later he was engaged in highway engineering—as chief engineer for the Morgan District Roads, county road engineer for Monongalia County, division engineer for the West Virginia State Road Commission, and consulting engineer for the West Virginia Public Service Commission. He was an alumnus of West Virginia University.

Frederic Dearborn Foss (M. '40), age 59, president of Foss-Halloran-Narr, Inc., construction engineers of Long Island City, N.Y., died on June 17, while on a business trip to Trenton, N.J. Before forming his firm in 1947, Mr. Foss was vice-president of the Corbetta Construction Co., New York, for seven years. Earlier he had been associated with the Fred T. Ley Co., the Fred F. French Co., and the New York City Housing Authority. He was an alumnus of the Massachusetts Institute of Technology.

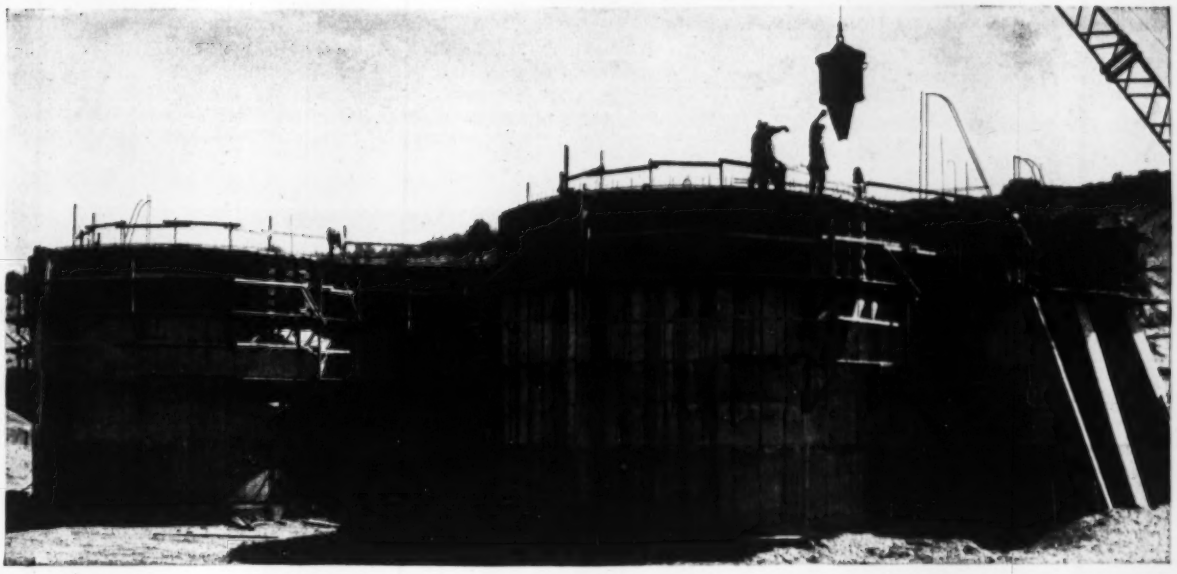
Norman Rae Green (J.M. '51), age 29, engineer with the Aluminum Company of America, died on July 3 as a result of injuries suffered in an accident at its Rockdale (Tex.) Works. Prior to his association with Alcoa, Mr. Green was a civil engineer in the construction division of E. I. du Pont Co. at Orange, Tex. He graduated from the University of Alabama in 1951 with the civil engineering degree.

Hans Arnold Grogg (J.M. '53), age 29, who recently returned to his native Switzerland after working as an engineer for the British Columbia International Engineering Co., Ltd., Vancouver (1952–1953), and the power division of the Bechtel Corp., San Francisco (1953–1954), died there on June 23. In Switzerland he had been employed by Losinger & Co., Ltd., at Berne, Zurich and Burgdorf. Mr. Grogg was a graduate of the Swiss Federal Institute of Technology and the University of Illinois.

Frank Arthur Johnson (M. '53), age 65, who retired in April as principal structural engineer in charge of structural design for the California State Division of Architecture after 20 years of service, died at Sacramento, on June 21. Before entering the Division as supervising structural engineer, Mr. Johnson was associated with H. J. Brunnier, of San Francisco, from 1919 to 1922, and maintained a private structural engineering practice in that city from 1922 to 1930. He attended the University of California.

John Albert Knighton (M. '05), age 86, retired engineer of New Rochelle, N.Y., died in that city on August 19. For thirty-seven years Mr. Knighton was with the Department of Plant and Structures (now part of the Department of Public Works) of New York City, serving as chief engineer from 1934 until his retirement in 1938. His work for the city included direct charge of the construction of the Queensboro Bridge. Earlier Mr. Knighton was employed by the Buffalo

(*Continued on page 92*)



STORAGE WALLS to hold sand and gravel, designed and engineered by Kaiser Engineering Co. Symons Pre-Fab Fir Plywood Forms were called upon for the work because they could be prefabricated to fit the need and on the basis of savings in time and money. Butler Construction & Engineering Co., Seattle, Washington, is the contractor.

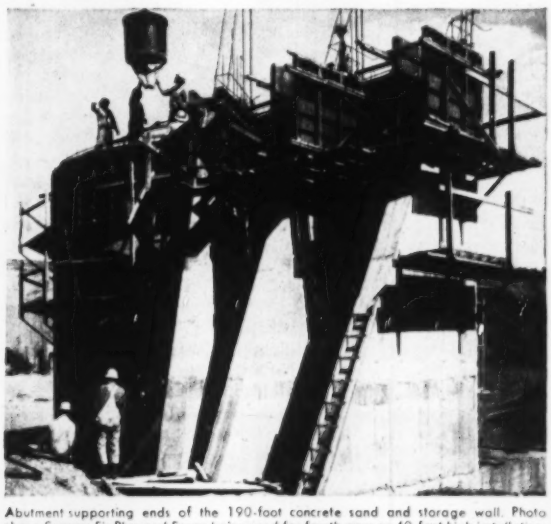
COST SAVINGS SELL SYMONS FIR PLYWOOD FORMS FOR 40 FT. HIGH "S" CURVED CONCRETE STORAGE WALLS

An unusual concrete construction job in Steilacoom City, Washington, involved the erection of two sharply curving free-standing concrete walls 40 feet high and 15 inches thick. The curves are shaped to a radius of 15 feet 6 inches. One wall is 190 feet long and the other is 400 feet long. They face each other across a space of 200 feet.

The curving surface of the walls posed a serious problem in forming. This was solved by the use of Symons Pre-Fab Fir Plywood Forms.

Most of the form panels were 2 x 6 feet with ¾ inch exterior *Plyform* faces framed on the edges with 2 x 4's and reinforced with steel cross members spaced 12 inches O.C. The job also required a number of filler panels 20 inches by 6 feet in which the plywood facing on each side extended past the framing 1⅛ inches, making it possible for the edges of the form to butt closely on the outside surface of the curves.

Symons Engineering and Customer Service also play an important role in projects where forming is a serious problem. The Symons Engineering Staff will furnish complete form layouts and job cost sheets on the form work—at no charge to the contractor. This service enables the contractor to get a clear picture of his job (its cost, bill of materials and labor saving methods). Symons fieldmen give regular on-the-job service. First, by on-the-job recommendations of forms and hardware needed. Second, by showing the workmen how to set up the forms efficiently. Third, by making special deliveries when last minute problems arise.



Abutment supporting ends of the 190-foot concrete sand and storage wall. Photo shows Symons Fir Plywood Forms being used for fourth pour on 40-foot high installation.

Symons Forming System includes just 3 pieces. TWO WAY FORM TIE which holds form securely to the required wall thickness without washers, spreaders or walers. Tie-ends are broken back within wall by a half-twist after forms are removed. TIGHTENING WEDGE is inserted through the slot in the connecting bolt and pulls form sides tightly together. CONNECTING BOLT which is slotted passes through edges of adjacent forms and tie loop.

JUST 3 PIECES

The Symons Forms are available on a Rental-Purchase Plan which offers contractors the opportunity to use the Symons Forming System on a rental basis . . . with all rental charges to apply on the purchase price, during a 60-day period.

Contractors throughout the country have tried this plan and like it. Send in your request for the complete facts—no charge or obligation.

SYMONS CLAMP & MFG. CO.
4291 Diversey Ave., Chicago 3, Ill. Dept. J-4

Please send catalog and information regarding:

☐ Forms ☐ Shores ☐ Column Clamps

Name_____

Firm Name_____

Address_____

City_____ Zone___ State____

Deceased

(*Continued from page 90*)

Grade Crossings Commission for ten years. He was an alumnus of Cornell University, class of 1891.

Charles Edson Martin (J.M. '52), age 25, Second Lieutenant, Army Air Force, was killed near Sioux City, Iowa, while piloting a sabre jet plane. Lieutenant Martin had received his training at Spence Air Force Base, Moultrie, Ga. He graduated with the degree of bachelor of civil engineering from the University of Florida in June 1952.

George Earl Martin (M. '40), age 67, retired consulting engineer for the paving material department of the Barrett Division of the Allied Chemical & Dye Corp., New York, N.Y., died in New Rochelle, on July 5. Mr. Martin graduated from Purdue University and took advanced studies at the University of Illinois. From 1910 to 1920 he was an instructor and professor of highway engineering at Purdue. In the latter year he joined the Allied Chemical & Dye Corp. as a highway engineer, and from 1926 until his retirement in 1953 was consulting engineer for the firm.

Louis Carl Mayer (M. '31), age 74, retired engineer of Beverly Hills, Calif., died on January 28. In the Los Angeles municipal service for most of his career, Mr. Mayer was assistant engineer in the city engineer's office from 1912 to 1921 and from 1925 to 1936, and a civil engineer in the bureau of engineering from 1937 until his retirement in 1948. At various periods he also had a private practice and worked for the city engineers of Phoenix, Ariz., and Salt Lake City, Utah.

Arthur Roscoe McGinness (A.M. '44), age 70, who retired on May 8 after 30 years of service with the Bureau of Reclamation, died at his home in Sacramento, Calif., on July 26. A 1910 graduate of the Colorado State College, Mr. McGinness joined the Bureau in 1912, leaving in 1927 to work for the City of Long Beach, Calif., as a structural engineer. In 1936 he returned to the Bureau as designing engineer in the supervising engineer's office in Sacramento. At the time of his retirement he was assistant regional engineer.

Edwin Charles Miller (M. '41), age 53, since 1945 partner in the Detroit, Mich., firm of Miller-Thompson Co., died in November 1953. Mr. Miller was associated with several Detroit organizations during his career, including Hubbell, Roth & Clark, the Gargaro Co., and Drainage Contractors, Inc. He was an alumnus of the University of Michigan.

John William Moffett (M. '33), age 66, 1941 assistant chief engineer and project director of Giffels & Vallet, Inc., Detroit, Mich., died recently. Mr. Moffett had been chief engineer of the Concrete Steel Co., New York, N.Y. (1912–1916) and the Sperry Engineering Co., New Haven, Conn. (1916–1925); general manager of the Harris Construction Co., Stamford, Conn. (1925–1927); chief structural engineer, Day & Zimmermann Engineering & Construction Co., Philadelphia (1927–1928); and supervising and chief engineer of United Engineers & Construction Co., Philadelphia (1928–1940). He was an alumnus of Rutgers University.

Emery Oliver (M. '06), age 91, retired engineer of Sacramento, died in that city on July 26. Engaged in railroad engineering for 22 years Mr. Oliver was with the Oregon-Washington Railroad & Navigation Co. and the Union Pacific and Western Pacific railways. He became chief engineer of the newly-formed Natomas Co., of California in 1910, and was general manager from 1914 until his retirement in 1929.

Willard Fred Pond (A.M. '16), age 72, former railroad engineer of Rochester, N.Y., died at his home there on August 1. Mr. Pond had been connected with the Buffalo, Rochester & Pittsburgh Railway and the Baltimore & Ohio Railroad for 43 years. At the time of his retirement in 1948 he was assistant regional engineer for the B. & O. In recent years he served as consulting engineer for the City of Rochester in charge of extensive grade crossing eliminations. Active in Society affairs he was vice-president of the Rochester Section in 1926 and president in 1928.

Kemble L. Riddle (A.M. '46), age 53, tower design engineer with Blaw-Knox Co., Blawnox, Pa., died on May 20. He was with the firm from 1931 to 1933 and continuously since 1934 as structural, chief and tower design engineer. He had also worked for Alcoa at New Kensington, Pa.; the Independent Erection Co., Cleveland; and H. H. Robertson Co., and the Westinghouse Corp., both at Pittsburgh. He was a graduate of the Carnegie Institute of Technology.

Walter Francis Shattuck, Jr. (M. '42), age 47, chief construction engineer for the Abbott Laboratories, Chicago, Ill., and manager of the engineering division of Abbott International, died on January 7. Mr. Shattuck was associated with the firm from 1935 to 1938 and again since 1945. At various periods he was employed by Sargent & Lundy, the Starrett Building Co., and Shattuck and Layer, all of Chicago. He was a graduate of the University of Illinois.

Frederick Philip Stabell (M. '31), age 63, retired civil engineer and member of the Norwalk (Conn.) Planning Commission, died at his home in Rowayton on August 20. In 1923 Mr. Stabell became associated with Samuel W. Hoyt, Jr., Inc., of South Norwalk, and in 1939 was made president of the firm. He had been in retirement for the past three years. Mr. Stabell attended the Columbia University School of Engineering.

Merle Jay Trees (M. '18), age 71, chairman of the board of the Chicago Bridge & Iron Co., Chicago, Ill., died in that city on August 6. He graduated from the University of Illinois in 1907. Entering the employ of Chicago Bridge and Iron in 1908, Mr. Trees advanced to the post of vice-president in 1918, executive vice-president in 1942, and chairman of the board in 1945.

Homer Root Turner (M. '47), age 67, since 1931 assistant and associate highway engineer with the Connecticut State Highway Department, Hartford, Conn., died on February 28. Mr. Turner had been assistant engineer for Ford, Buck & Sheldon of Hartford (1909–1916) and superintendent and engineer for the Windsor Fire District, Windsor, Conn. (1916–1920). For eleven years (1920–1931) he was engaged in private consulting practice in Windsor. Mr. Turner was an alumnus of Tufts College, Medford, Mass.

Arrigo Mazzucato Young (M. '29), age 70, since 1940 senior partner in the firm of Young, Richardson, Carleton & Detlie, architects and engineers of Seattle, Wash., died there on June 27. Engaged in private practice since 1912, Mr. Young was connected with Schack, Young & Myers, architects and engineers from 1920 to 1928 and Schack & Young from 1929 to 1933, and from 1933 to 1940 maintained his own office. Active in civic matters, Mr. Young was a member of the Seattle Building Code Commission and the Planning Commission, and the designer of the Civic Auditorium there. He graduated from the University of Michigan in 1907.

New in Education

In recognition of the increased use of radiation and the associated health protection problems, the Public Health Service of the U. S. Department of Health, Education and Welfare is sponsoring a radiological health training program at the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. The program proposes to indoctrinate public health workers with the significance and hazards of ionizing radiations and recommended procedures for minimizing such hazards. Courses scheduled for 1954–1955 include Problems of Radioactivity in Water Works, November 1–5 and May 16–20; Basic Course in Radiological Health, January 10–21 and April 18–29; Occupational Radiation Protection, January 24–February 4; Radiation Hygiene-Preventive Medical Aspects, March 7–10; and the Environmental Radiation Sanitation Course, May 2–13. For further information address the Chief, Radiological Health Training Section, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

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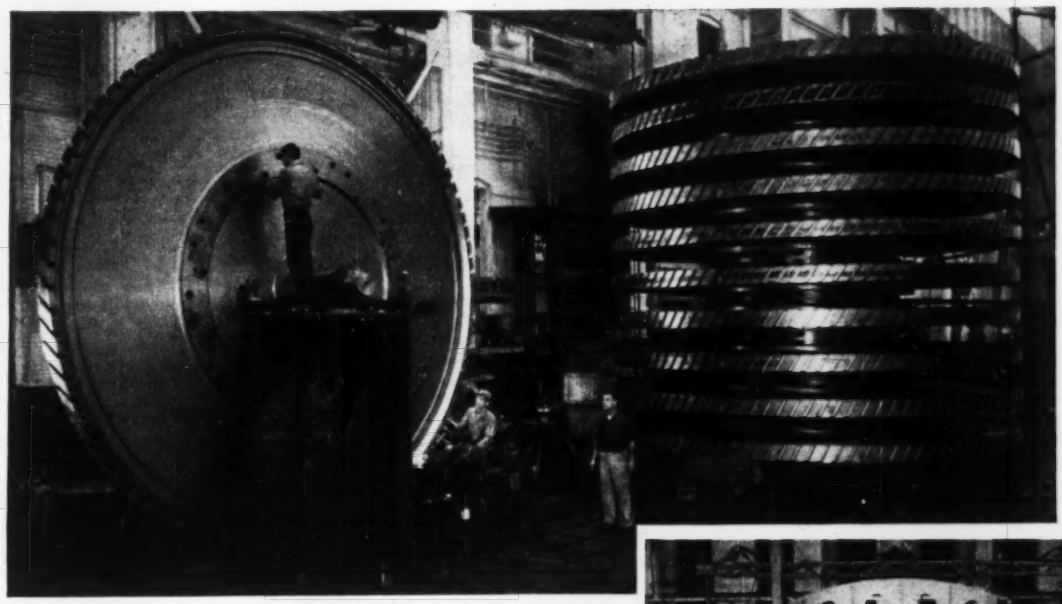
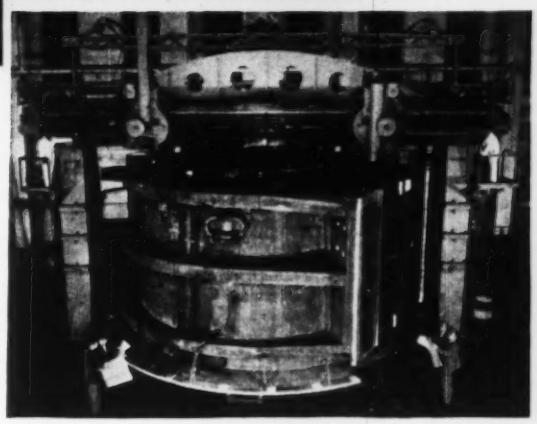


Rotor discs for mammoth 11-stage compressor were balanced and stacked for alignment in one of Newport News' five huge machine shops. Large engineering and technical staffs with a vast plant make Newport News an ideal source for large equipment . . . *standard or special in design.*



A 35-foot boring mill in Newport News' plant machining the 374,000-pound upstream housing for the giant axial flow compressor. The compressor is heart of an 8-foot supersonic wind tunnel at the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics at Moffett Field, Calif.

To create winds exceeding

2000 MPH

Newport News builds world's Mightiest Compressor

Whenever you want large units built with careful attention to detail, give the job to Newport News.

This company recently built an eleven-stage axial flow compressor that shatters all previous records for wind force . . . using what is believed to be the world's largest rotating object.

The rotor, weighing more than 400 tons, comprises eleven huge discs. Each disc, machined from a 96,000-pound forging, was finished to a 50,000-pound wheel and balanced to within 26 ounces at the rim. In each rim, slots for blades were machined to within .005" on special milling heads designed and produced in the Newport News plant.

Here at Newport News, you'll find more than large productive capacity. In machine shops, foundries and forging plants Newport News craftsmen complete your orders with specialized techniques backed by experience in fabricating thousands of products.

Newport News' craftsmen produce units that range from small components of spinning machines, to mammoth hydraulic turbines . . . from piping, pumps and valves, to vacuum tanks, digesters and bridge caissons.

These skilled men handle the job exactly as you want it done, for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and products" . . . it's your for the asking.

Newport News

Shipbuilding and Dry Dock Company

Newport News, Virginia

New in Education

(*Continued from page 92*)

The Evening College of the Drexel Institute of Technology is offering a refresher course for professional engineers preparing for state examinations for licenses. The course will be divided into two sessions. Part I, consists of a ten-week review of mathematics and basic science and will meet for registration on October 7 at 8 p.m.; Part II, a twenty-week study of engineering problems, will meet for registration on January 6, 1955, at 8 p.m. Tuition fees are $45 and $85.

Illinois Institute of Technology plans to begin construction of a glass and steel building which will house its department of architecture, the Institute of Design, and a new department of urban and regional planning. Architects, contractors, and building material suppliers in the Chicago area are canvassing industry for gifts to assist the institute in financing the new center. A goal of $300,000 has been set—approximately half the cost of the proposed building.

Completing its first year in operation, Westminister College in Salt Lake City, Utah, reports with optimism that its experiment in engineering education appears to be meeting with success. The school has supplemented its teaching staff with the services of members of a private consulting firm—the Metropolitan Engineers, Inc., of Salt Lake City. In this way, the practical as well as theoretical aspects of engineering are emphasized. Expansion of the present course of study to a four-year curriculum and eventual establishment of a school of engineering is envisioned by Dr. Richard Palmer, president of the college.

A new scholarship program for engineering and physical science undergraduates will be established this fall at six universities by the Corn Products Refining Co. The aim of the program is to help relieve the shortage of competent science and engineering graduates. Six scholarships—one to an institution—will be awarded every fall to qualified high school students. Each scholarship is worth $600 a year and can be renewed to cover the four-year college period.

In a further expansion of its nine-year-old fellowship program, the Minneapolis-Honeywell Regulator Co. announces the recent establishment of two post-graduate fellowships for engineering and physics students set up with Purdue University and Tau Beta Pi, honorary engineering society. Seven fellowships, ranging in value from $1,200 to $2,700, are available at the University of Minnesota, Massachusetts Institute of Technology, Missouri and Iowa State, and Purdue University.

A course in prestressed concrete structures, with emphasis on American practice, is being offered at the Polytechnic Institute of Brooklyn this semester. Prof. Odd Albert and others will lecture. The class meets Thursday evenings, 8 to 10.

RECENT BOOKS

Engineering Mechanics

An undergraduate textbook for students with a knowledge of physics and calculus. In this edition there has been some rearrangement of the subject matter, there is new material on friction, vibrations, and some other subjects, and most of the problems are new or revised. The authors are Glen N. Cox and William G. Plumtree. (D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N.Y., second edition, 1954. 382 pp., $5.50.)

Engineers' Dreams

Nine projects that could be accomplished if it were not for political and economic difficulties are the subject of this book by Willy Ley. These include a tunnel under the English Channel, "seadromes," harnessing volcanoes and hot springs, creating a lake in the Congo Basin, shrinking the Mediterranean by building a dam at the Strait of Gilbraltar, and obtaining power from the sun, waves and wind. (Viking Press, 18 East 48th St., New York 17, N.Y., 1954. 239 pp., $3.50.)

A History of the School of Engineering, Columbia University

Emphasis is on the role of the School of Engineering in the rise of the United States to industrial pre-eminence and in the development of Columbia into a great university. Included by the author, James Kip Finch, is an account of the contributions of early nineteenth century engineers who received their basic instruction at King's College, the founding of the School of Mines in 1864, and the departmentalization of the School of Engineering. (Columbia University Press, 2960 Broadway, New York 27, N.Y., 1954. 138 pp., $2.75.)

Spannbeton-Richtlinien Fur Bemessung und Ausfuhrung-DIN 4227 and Spannbeton-Erlauterungen zu DIN 4227

This pamphlet by Hubert Rüsch, contains the German specification DIN 4227 on prestressed concrete and supplementary explanations and directions for dimensioning and design in connection with the specification. (Wilhelm Ernst & Sohn, Berlin, 1953. 27 pp., 57 pp., DM 5.00.)

Steel Rigid Frames Manual
Design and Construction

Part one presents the fundamentals of analysis and design, including selection of type of frame, derivation of basic equations, and tables of design for single span frames of from 50 to 150 feet. Part two of the volume is a collection of actual designs of a number of structures—an auditorium, bridges, and others. Martin P. Korn is the author. (J. W. Edwards, Inc., Ann Arbor, Mich., 1953. 170 pp., $4.50.)

Surface Protection Against Wear and Corrosion

The first part of this book is a summary of techniques and metallurgical facts that aid craftsmen, technicians, and engineers in minimizing surface wear of metallic materials. Among the processes dealt with are plating, metal spraying, hard facing, etc. The second part contains eight lectures on surface protection against corrosion, covering economics, specifications, and various types of coatings. References are appended to each chapter. (American Society for Metals, 7301 Euclid Avenue, Cleveland, 1954. 461 pp., $6.)

Thermodynamics Refresher for Professional Engineers License

This separate publication is a revision and enlargement of the section on the subject in the author's—John D. Constance—Refresher Notes. Additions have been made which are intended to increase the value of the material to examination candidates in all states. There is a new section on air conditioning, and other subjects, for example, heat transfer, are treated more extensively. (John D. Constance, 625 Hudson Terrace, Cliffside Park, N.J., 1954. $3.25.)

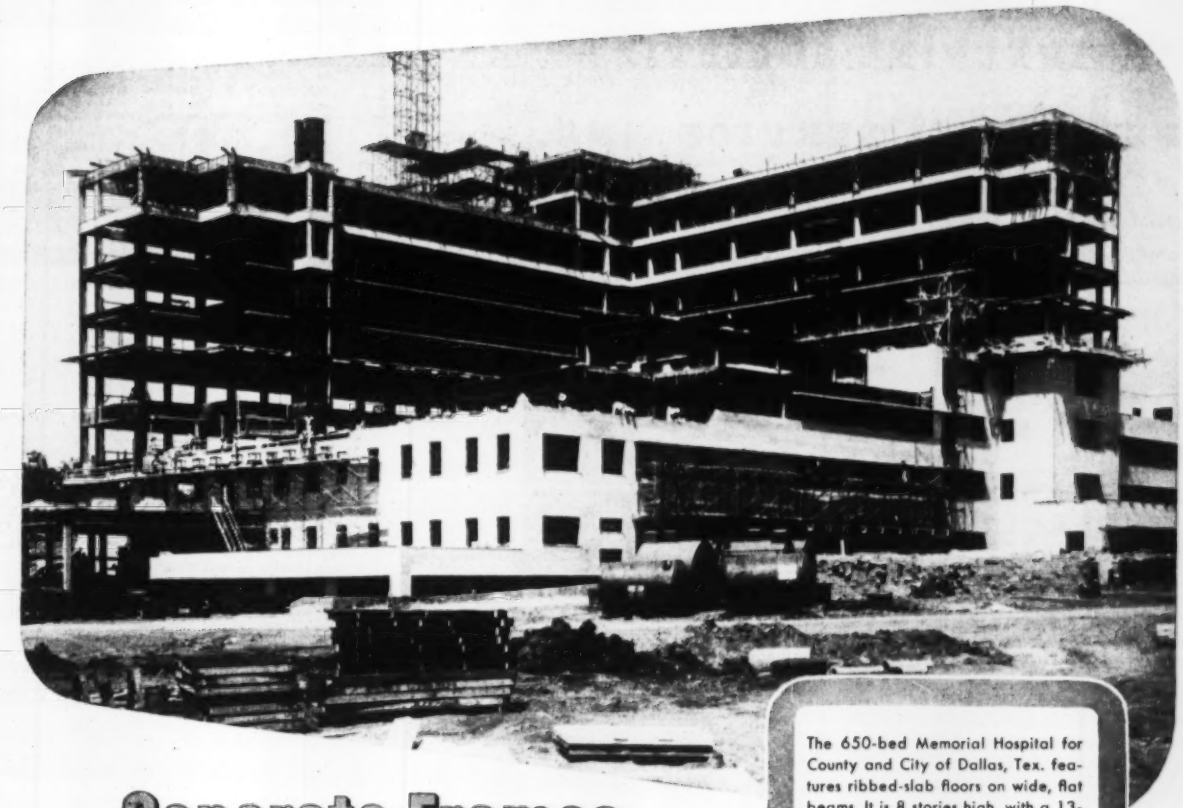
Positions Announced

Wayne County, Michigan. The Civil Service Commission of Wayne County, Michigan, announces an open competitive examination to fill the post of Civil Engineer V (Sanitary) at a salary ranging from $7,879 to $8,959 a year. Applicants are required to be citizens, under 50 years of age, graduates of an accredited college with a bachelor of science degree in civil engineering with specialization in sanitary engineering, and to have five years of sanitary engineering experience including two in a supervisory capacity. Further information and application forms are available from the Wayne County Civil Service Commission, 2200 Cadillac Tower, Detroit 26, Mich.

City of Philadelphia. Several vacancies now exist for the position of Sanitarian I (Engineering) in the Division of Environmental Sanitation of the Philadelphia Department of Public Health. The salary range is $4,108 to $5,160 in five annual increments. Candidates must be graduates of a four-year college or university course, with major work in sanitary, civil, mechanical or chemical engineering. For additional information and application forms, write to Andrew L. McCabe, Jr., Assistant Personnel Officer, Department of Public Health, Room 503, City Hall Annex, Philadelphia 3, Pa.

City of Wauwatosa, Wis. The City of Wauwatosa (a community of 45,000 covering an area of 12½ square miles) is seeking a city engineer to have administrative and technical charge of the municipal engineering department and allied departments. Requirements are a degree in civil engineering, Wisconsin registration or eligibility thereto, and ten years of progressively responsible civil engineering experience. Maximum age 50 years. Starting salary $700 to $800 per month depending on applicant's qualifications. For further information apply before October 15, to the Wauwatosa

(*Continued on page 97*)



The 650-bed Memorial Hospital for County and City of Dallas, Tex. features ribbed-slab floors on wide, flat beams. It is 8 stories high, with a 13-story center section. Architects: Dewitt and Swank; structural engineer: R. L. Rolfe; contractor: Robert E. McKee. All are from Dallas.

Aerial view below shows the hospital against Dallas skyline. Excavation in foreground is for the Southwestern Medical School Basic Science Building. It also is designed for reinforced concrete frame and floor construction.

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All applications should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

STRESS ANALYST; J.M. ASCE; M.S.C.E.; 31; married; 5 years' research experience in theoretical and experimental projects involving product development, structural design and production problems. C-995.

CIVIL ENGINEER; J.M. ASCE; registered P.E.; 32; single; Case Institute of Technology, also a degree in civil engineering from Europe; speaks 6 languages; 8 years' experience in design, construction and sales. C-996.

CIVIL ENGINEER; J.M. ASCE; 25; single; B.S.C.E., 1951; 3 years' experience as base sanitary engineer in U.S.A.F. Desires job in water supply and sewage design, subdivision or municipal work. C-997-802-A-San Francisco.

ADMINISTRATOR-EXECUTIVE; J.M. ASCE; 29; single; civil engineering and Yale Law School degrees; 3 years as sales manager in construction materials for large export firm, assistant to vice-president; 2 years' broad and varied engineering experience in structural steel, highway construction and concrete. C-998.

Positions Available

CIVIL ENGINEER, 26–30, for estimating and valuation of buildings and structures for fire insurance purposes. Salary, $4,500–$4,800 a year. Location, New York, N.Y. Y-9852.

ADMINISTRATIVE ENGINEER, civil, mechanical or chemical graduate, with 7 to 15 years' experience in a gas utility field and must be capable of directing engineering activities, as well as evaluating operating methods and results. Salary open. Location, Connecticut. Y-9895.

CIVIL ENGINEERS. (*a*) Civil Engineer, graduate, with some municipal experience, particularly on streets and sewers. Salary, $4,170–$5,670 a year. (*b*) Junior Civil Engineer, graduate, with about one year's experience in general civil engineering and some knowledge of streets and sewers. Salary, $3,500–$4,100 a year. Must be residents of northern New Jersey. Y-9932.

CIVIL ENGINEER experienced in supervision of triangulation surveys. State education, experience, salary desired. Location, Midwest. Y-9977.

CHIEF TECHNICAL SPECIFICATION WRITER, with 5 years' experience on airports, airfields, piers, buildings, etc., for Spain. Prefer experience with architectural firm. Salary, $10,000 a year. Seventeen-month contract. F-21(*a*).

HIGHWAY ENGINEER, 30–40, at least 10 years' highway experience including responsible charge in important positions for at least 3 years. Must be able to write clear reports and to make effective oral presentations to both technical and lay groups. Position requires some traveling. Headquarters in eastern city. W-107.

INSTRUCTOR OR ASSISTANT PROFESSOR in civil engineering department, with B.S. or M.S. degree, with or without teaching experience. Should be able to teach soil mechanics, hydraulics, water supply and sewerage, highway design and plain concrete. Salary, about $4,000 for nine months. Location, West. W-221.

CONSTRUCTION ENGINEER, 30–35, who has had some experience laying pipe lines, preferably cast iron. The job would entail considerable traveling, supervising the installation of the company's product. Salary, to $10,000 a year. Location, East. W-229.

ASSISTANT MANAGER, 20–35, for general building contractor on earth work, sewer installations, water installations, curb and roads on large housing projects. Experience with earthmoving and road-building machinery helpful, but not essential. Location, Pennsylvania. W-231.

RESEARCH ENGINEER, 35–45; civil engineering graduate, who majored in structural design; master's degree desirable. Experienced in the theory and design of structural steel; ability to write technical reports and lead discussions. Must have the ability to speak informally at meetings. Design experience in the use of reinforced concrete and other structural materials. Location, New York, N.Y., W-312.

JUNIOR ENGINEERS, civil, mechanical or electrical graduate, for inspection and field engineering covering process equipment installation. Must be citizens. Salary, $4,800–$5,400 a year. Location, southern Nevada. W-339.

STRUCTURAL ENGINEERS with experience for highway bridge design. Location upstate New York. W-353.

OFFICE AND EDITORIAL ASSISTANT, civil graduate, young, with construction experience, to prepare reports, articles and reviews covering heavy construction for engineering firm. Must be good technical writer. Salary, $4,800–$5,400 a year. Location, New York, N.Y. W-356.

DESIGNER, civil or structural engineer, with experience in structural design for all types building construction. Salary open. Location, eastern Pennsylvania. W-417.

OFFICE ENGINEER, civil or architectural engineering graduate, with at least 5 years' institutional or multi-story fireproof building construction experience with qualified contractors, to be responsible for job changes, specifications, quantities and general responsibility covering subcontractors. Salary, $6,500–$9,100 a year. Location, New York, N.Y. W-443.

ENGINEERS. (*a*) Sales Engineer, 26–35, civil graduate, with concrete experience, for technical field work with customers of cement manufacturer. Salary, $4,800–$6,000 a year. (*b*) Junior Engineer with civil engineering training, to develop into concrete technician and assist sales and service engineers. Training period in eastern Pennsylvania with various locations in eastern and southern states available. Salary, $3,600–$4,800 a year. W-453.

PROJECT ENGINEER, civil graduate, over 40, with at least 10 years' hydroelectric experience covering planning, design and general layout of dams, tunnels and power plant. Salary, $10,000–$12,000 a year. Location, New York, N.Y. W-460.

CONSTRUCTION ENGINEER, paper mills; with at least 5 years' experience in paper mill design and layout. Knowledge of paper mill operations. Will supervise office end of construction project on designing, laying out and building of new paper mill. Salary, $8,400–$10,000 a year. Employer will negotiate fee. Location, Texas. C-2093.

DESIGNER, graduate civil engineer, with 4 to 6 years' experience in design and drafting particularly in municipal waterworks and sewage with consulting or city engineer. Salary, to $6,000 a year. Location, Nebraska. C-2171.

SENIOR SPECIFICATIONS WRITER LOCATION—EUROPE

The person we are looking for should have heavy experience writing specifications for all types of structures, utilities, airfield and harbor facilities, plus a knowledge and evaluation of materials and equipment through foreign sources of supply.

The individual selected will be required to sign an 18-month contract and will be exempt from U.S. and foreign income taxes. As the location is in one of Europe's largest cities, there are no family restrictions.

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Highway and Bridge Designers with two to five years experience wanted for permanent position.

Write to

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245 North High St.

Columbus, Ohio

Positions Announced

(*Continued from page 94*)

Civil Service Commission, 7616 Harwood Ave., Wauwatosa 13, Wis.

Division of Waterways, State of Illinois. Applications are now being received for two positions as Civil Engineer, one with up to three years' experience in structural engineering and one with at least ten years' experience in structural engineering. The salaries range from $250 to $660 a month. Write to the Division of Waterways, State of Illinois, 201 West Monroe St., Springfield, Ill., giving a brief resume of education and experience.

Applications for Admission to ASCE, Aug. 14–Sept. 4

Applying for Member

WARREN FISHER DANIELL, Millinocket, Me.
ELMER AUGUST DEKARSKE, Milwaukee, Wis.
WARD W. ENGLE, Knoxville, Tenn.
JOHN THOMAS FISHER, New York, N. Y.
GUSTAV FLOREN, Lincoln, Nebr.
CHARLES GARDNER GROSH, Los Angeles, Calif.
WILLIAM HENRY GOINES, Jackson, Miss.
JOHN LEON HOFFMAN, Atlanta, Ga.
HERMAN LEHMAN HOLSOPPLE, Rome, Ga.
CHUNG YUAN LI, Harrisburg, Pa.
PASQUALE MARTELLI, West Hartford, Conn.
THOMAS MARSHALL PATTON, Augusta, Ga.
EUGENE GEORGE RAU, New York, N.Y.
JOHN HENRY ROBINSON, Los Angeles, Calif.
EMIL SCHMID, Passaic, N.J.
VICTOR EVERETT SCOTTRON, Storrs, Conn.
FRANK TETZLAFF, Ridgewood, N.J.
JEAN FRANCOIS LOUIS VAN RYSSELBERGE, Chicago, Ill.
HENRYK JAN WALOCHA, Los Angeles, Calif.

Applying for Associate Member

WILLIAM SIDNEY GARNETT BRITTON, Richmond, Va.
PHILIP EMILE BROUILLET, JR., Levittown, N.Y.
BRENDAN KENNETH CLANCY, Nigeria, West Africa.
PAUL MEREDITH COOK, Vancouver, B.C., Canada.
EDWIN RICHARD HENRY DAVIS, Auckland, N.Z.
LARUE ELDRED DELP, Topeka, Kans.
FRANCIS EUGENE DUBUISSON, New York, N.Y.
HERBERT SAMUEL HART, Calcutta, India.
CARL OTTO KNOP, Omaha, Nebr.
EDWIN LEE KNOWLES, Troy, N.Y.
ALLISON FULLER KRAFT, Newport News, Va.
CARL FERDINAND LIND, Los Angeles, Calif.
RAYMOND WESLEY LITTLE, San Francisco, Calif.
KARL JOSEPH MAIER, San Francisco, Calif.
ANTHONY MASTROLEMBO, Cleveland, Ohio.
SAMUEL HAMILTON MORTIMER, Baltimore, Md.
BHUPESH NANDI, West Bengal, India.
FRANK LOUIS NILSEN, Salt Lake City, Utah.
EPIC ERNEST OAKES, Singapore, Malaya.
GEORGE WALTER O'NEILL, Chile, S.A.
ANTHONY ROMANIUK, Chicago, Ill.
THORNTON EDWARD SMITH, New York, N.Y.
SUMNER SVEDIN STEWART-MAGEE, New York, N.Y.
PAO-CHANG PAUL SUN, Sacramento, Calif.
FRANCIS CHAPLIN TYLER, Boston, Mass.
IFTIKHAR ALI ZAFAR, Lahore, Pakistan.

Applying for Junior Member

JOSEPH BELL, JR., Juneau, Alaska.
KENNETH JAY GIOVANNETTI, Chicago, Ill.
DONN ARLEN HUBER, Seattle, Wash.
JOHN ARNOLD KARL, Albertson, N.Y.
GEORGE CROSBY LENFESTEY, JR., San Francisco, Calif.
LYNDON HAROLD MOORE, Latham, N.Y.
JOHN CHARLES NEUDORFER, New London, Conn.
ROBERT GERALD NIEBUR, South Pasadena, Calif.
PEDRO ANTONIO DEL RIO ORTIZ, Yauco, Puerto Rico.
EDWARD HAROLD RUBIN, Los Angeles, Calif.
HARLAN ERNEST SCHMIDT, Mankato, Minn.
WILLIAM LESLIE SHEAFER, II, Jackson, Ohio.
PETER ANDREW SUDEN, Spokane, Wash.
DAVID GERALD UBTRECHT, Hammond, Ind.
JAMES GEORGE WALLACE, Los Angeles, Calif.
JOHN CHARLES WOODS, Wilmington, Del.

[*Applications for Junior membership from ASCE Student Chapters are not listed.*]

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Preprints From 1954 Transactions, Vol. 119, Now Available

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Advance reprints, or "preprints," of all papers to be included in the 1954 volume of the TRANSACTIONS of ASCE are now available, although publication of the volume itself (Vol. 119) has not yet been completed. Each preprint is bound in an individual stiff paper cover and contains one paper or one symposium complete with all the discussions received, and the author's closure. These may be ordered by encircling the number preceding each paper desired on the following list, filling out the form below, and mailing this entire page with your remittance to ASCE at the above address. Prices listed are for non-members. **ASCE members receive a 50 percent discount on all preprints.**

Note: Numbers in parentheses are those of the Proceedings-Separates in which the papers originally appeared.

2656 **Ice Pressures Against Dams: A Symposium,** by Bertil Lofquist, A. D. Hogg, and G. E. Monfore (160, 161, and 162) 90¢

2657 **Stiffness Charts for Gusseted Members under Axial Load,** by John E. Goldberg (179) 40¢.

2658 **Electronic Devices in Air Transport,** by F. B. Lee (173) 30¢.

2659 **Dam Modifications Checked by Hydraulic Models,** by E. S. Harrison and Carl E. Kindsvater (184) 40¢.

2660 **Rapid Computation of Flexural Constants,** by Thomas G. Morrison (170) 30¢.

2661 **Special Design Features of the Yorktown Bridge,** by Maurice N. Quade (168) 30¢.

2662 **Unified Mass-Transportation System for New York,** by William Reid (171) 30¢

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2666 **Earthquake Stresses in Shear Buildings,** by M. G. Salvadori (177) 70¢.

2667 **Velocity Measurement of Air-Water Mixtures,** by Lorenz G. Straub, John M. Killen, and Owen P. Lamb (193) 30¢

2668 **Radial Impact on an Elastically Supported Ring,** by Edward Wenk, Jr. (157) 60¢.

2669 **Rainfall Studies Using Rain-Gage Networks and Radar,** by H. E. Hudson, Jr., G. E. Stout, and F. A. Huff (178) 60¢.

2670 **Zoning Maps for Airports,** by Benjamin Everett Beavin, Sr., (174) 30¢.

2671 **The Equivalent Rectangle in Prestressed Concrete Design,** by John J. Peebles (187) 40¢.

2672 **Nonelastic Behavior of Bridges under Impulsive Loads,** by S. J. Fraenkel and L. E. Grinter (185) 50¢.

2673 **Friction Factors for Turbulent Flow in Pipes,** by Edward F. Wilsey (197) 20¢.

2674 **Group Loadings Applied to the Analysis of Frames,** by I. F. Morrison (183) 40¢.

2675 **Design of Side Walls in Chutes and Spillways,** by D. B. Gumensky (175) 40¢.

2676 **The Design of Flexible Bulkheads,** by James R. Ayers and R. C. Stokes (166) 60¢.

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2685 **Numerical Analysis of Continuous Frames in Space,** by James Michalos (261) 40¢.

2686 **Revenue Bond Financing for Airport Improvements,** by James C. Buckley (260) 30¢.

2687 **Snow Hydrology for Multiple-Purpose Reservoirs,** by Herbert S. Riesbol (189) 70¢.

2688 **Wave-Wash Control on Mississippi River Levees,** by Rudolf Hertzberg (275) 30¢

2689 **Design Curves for Anchored Steel Sheet Piling,** by Walter C. Boyer and Henry M. Lummis, III (165) 40¢.

2690 **Algae Responsible for Odor and Taste in Water Supplies,** by George J. Turre (267) 20¢.

2691 **Analysis of Corrective Actions for Highway Landslides,** by R. F. Baker (190) 70¢.

2692 **Post-Buckling Strength of Redundant Trusses,** by E. F. Masur (332) 30¢.

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2694 **Deflection of Laminated Beams,** by L. G. Clark (331) 30¢.

2695 **Bridges on the West Virginia Turnpike,** by Elmer K. Timby (263) 20¢.

2696 **Hipped Plate Analysis, Considering Joint Displacements,** by Ibrahim Gaafar (182) 90¢.

2697 **Putting a Sewage Treatment Plant into Operation,** by Benjamin Benas (257) 30¢.

2698 **Stresses in the Corners of Rigid Frames** by Harvey C. Olander (249) 30¢.

2699 **Continuous Composite Steel and Concrete Beams,** by John Sherman (251) 40¢.

2700 **Lateral Buckling of Channels and Z-Beams,** by H. N. Hill (334) 30¢.

2701 **Relief Well Systems for Dams and Levees,** by W. J. Turnbull and C. I. Mansur (192) 80¢.

2702 **Wind Loads on Truss Bridges,** by John M. Biggs (201) 40¢.

2703 **Mass-Concrete Operations in the Rocky Mountains,** by George P. McIndoe (268) 30¢.

2704 **Amplification of Stress in Flexible Steel Arches,** by Robert S. Rowe (245) 40¢.

2705 **Frequency of Excessive Rainfalls in Florida,** by David B. Smith (366) 20¢.

2706 **Plates with Boundary Conditions of Elastic Support,** by S. J. Fuchs (199) 70¢

2707 **An Interstate Route and Its Urban Connections,** by D. W. Ormsbee (329) 30¢

2708 **Live Loading for Long-Span Highway Bridges,** by R. J. Ivy, T. Y. Lin, Stewart Mitchell, N. C. Raab, V. J. Richey, and C. F. Sheffey (198) 50¢.

2709 **Peak Discharge for Highway Drainage Design,** by Carl F. Izzard (320) 40¢.

2710 **Design Charts for Air Chambers on Pump Lines,** by W. E. Evans and C. C. Crawford (273) 50¢.

2711 **Electrical Analogs of Statically Loaded Structures,** by Frederick L. Ryder (376) 40¢.

2712 **River-Bed Scour During Floods,** by E. W. Lane and W. M. Borland (254) 50¢.

2713 **Highway Bridges on Deep Foundations,** by Louis Duclos (276) 30¢

2714 **Mechanics of Manifold Flow,** by John S. McNown (258) 80¢.

2715 **Design of Frames by Relaxation of Yield-Hinges,** by J. Morley English (322) 30¢.

2716 **Laminar to Turbulent Flow in a Wide Open Channel,** by W. M. Owen (188) 40¢

2717 **Analysis of Water Hammer by Characteristics,** by C. A. M. Gray (274) 10¢

2718 **Joint Translation by Cantilever Moment Distribution,** by L. E. Grinter and C. H. Tsao (298) 40¢.

2719 **Turbulent Boundary Layer on Steep Slopes,** by William J. Bauer (281) 60¢.

2720 **Anchored Bulkheads,** by Karl Terzaghi (262) $1.60.

2721 **The Engineer and World Population: Address at the Summer Convention,** Atlantic City, N. J., June 16, 1954, by Daniel V. Terrell, President; 20¢.

Please send me the papers indicated by the encircled numbers. I enclose payment in the amount of $..... I am ...., am not .... a member of ASCE. If more than one copy of a paper, is desired, indicate here:

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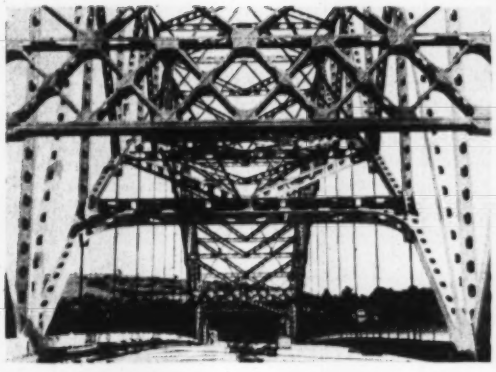

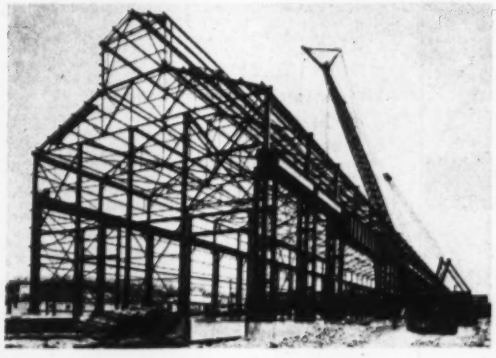

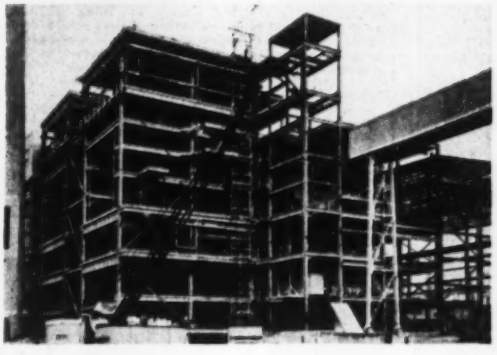

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CATALOG DIGESTS of ENGINEERING and INDUSTRIAL interest

1 AD-40 MOTOR GRADER

Allis-Chalmers Manufacturing Company—The AD-40 motor grader, largest in the Allis-Chalmers grader line, is described in this 16-page color catalog. In addition to describing such features as "Hydraguide" steering, extra high clearance, easy working controls, and full visibility for the operator, the catalog also includes action pictures showing what the various features mean in terms of work the AD-40 can do. Power is provided by a Diesel engine with a rated 104 brake h.p.

2 AERIAL CONVEYORS

Sauerman Bros., Inc.—Sixteen pages of photographs, sketches, and text describe types, spans, working loads and other details of tautline cableways. This new 3-color catalog illustrates cableway applications that will be of interest to civil and consulting engineers, public utilities and industrial concerns.

3 AERIAL MAPPING

Aero Service Corporation—Offers catalogs or literature covering new and more economical applications of varied aerial mapping services. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, airborne magnetometer surveys for ore and oil, and both plastic and plaster relief maps. Services discussed are used in highway design, plant engineering, industrial development, community planning, geological explorations and prospecting for oil or minerals.

4 AERIAL SURVEY AND MAPPING METHODS

Fairchild Aerial Surveys, Inc.—Aerial Survey and Mapping methods—particularly in relation to engineering and planning problems are described and illustrated in "Focusing on Facts," available when requested on your business letterhead.

5 ANALYSIS OF INDUSTRIAL ROOF CONSTRUCTION

H. H. Robertson Company—A Booklet on the better-known roof types (flat, monitor, bowstring, doublepitch, high-low bay, saw tooth) are compared on the basis of weight of structural steel, volume, roofing material, area of vertical sash, flashing required, natural ventilation, and natural daylighting—both intensity and cost. The data involved was computed by an eminent professional engineer for the purpose of evaluating the true cost and comparative efficiency of each roof design.

6 BATCHING PLANT

Heltzel Steel Form & Iron Co.—Bulletin N-33 discusses the Heltzel portable multi-purpose batching plant. Drawings for estimating purposes and batcher specifications are given. The Heltzel Dual Aggregate Batcher, Truck Mixing Batcher, Universal Batcher are described.

7 BITUMULS—TYPES AND USES

American Bitumuls & Asphalt Company—Has a 24-page, two color booklet, "Bitumuls for Maintenance" which is a fully-illustrated, valuable guide to modern methods, materials and equipment for the repair and maintenance of existing pavements. It covers the use of various types of emulsified asphalts with a wide range of aggregates.

8 BOILERS AND STOKERS

The James Leffel & Co.—Offers Boiler Bulletin 236 describing completely the 17 sizes of Scotch Marine Type Boilers and Leffel Underfeed Stokers. The bulletin contains full information on boiler construction, care and factors of performance.

9 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations," Catalog B-5 explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

10 CAST IRON PIPE, HYDRANTS AND VALVES

R. D. Wood Company—A new general catalog has recently been issued providing full details of weights and dimensions of "Sand Spun" Cast Iron Pipe and Cast Iron Fittings. This catalog also features "Mathews Modernized" and R. D. Wood Fire Hydrants, R. D. Wood Gate Valves and other products manufactured by this company.

11 CAR SPOTTERS

Link-Belt Co.—Capstan type car spotters and drumtype pullers are shown in Book 2092. Layout diagrams and selection charts assist in choosing one of the versatile, rugged stock units or in specifying a system to meet particular track arrangements or special operating conditions.

12 CAST-IN-PLACE PILES

C. L. Guild Construction Co., Inc.—Has a descriptive folder on the COBI cast-in-place concrete piles. It illustrates how the piles are driven, poured, and tested. The corrugated spiral shell is driven by a pneumatic mandrel expanded with 125 psi pressure. The company points out that the piles screw themselves into the ground, resisting both settlement and uplift. Another folder is available, which describes the use of the COBI pile on the New York Thruway.

13 CEMENT GUN

Cement Gun Company, Inc.—Of considerable interest to the engineering profession is a 65-page booklet, designated as Bulletin 2400, describing the cement gun and its applications. It covers the principal uses of "Gunite" and is profusely illustrated. In the last few pages of this bulletin are typical specifications for various types of "Gunite" work.

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Please have the literature indicated by the circled Catalog Digest numbers in the October 1954 issue sent to me without obligation.

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NOT GOOD AFTER November 15, 1954, for readers in the U.S., but requests will be accepted to December 30, 1954, from readers outside of this country.

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CATALOG DIGESTS

14 CHEMICAL FEEDER

%Proportioneers, Inc.%—New Bulletin 1910-1 describes a low capacity chemical feeder known as the "Chlor-O-Mite." It is a compact electrically operated diaphragm type feeder. Specifically designed for controlled feeding of Hypochlorite or water treating chemical solutions into small water systems, operating at not over 50 gallons per minute and 50 pounds per square inch pressure. All parts needed for the complete installation are furnished as a kit.

15 CONCRETE, ACCELERATING DENSIFIER

Sika Chemical Corporation—A 4-page brochure describes the action and use of Sikacrete, accelerating densifier in both concrete and mortar. It is shown how Sikacrete accelerates setting time and reduces water content without changing the air content of mortar or concrete. The result of this action is an increase in surface hardness, strength and resistance to water and cracking. Graphs illustrate the control of set made possible by Sikacrete at various temperatures.

16 CONCRETE ADMIX

American Bitumuls & Asphalt Company—A 4-page leaflet, "Pittsburgh Testing Laboratory Report on Hydropel, An Integral Admix for Waterproofing Concrete" as compared to other admixes is offered. Reproductions of the actual test reports from this independent laboratory, combined with explanatory graphs, charts, photographs and summaries, show the superiority of Hydropel concrete in resistance to water absorption.

17 CONCRETE CURING

Hunt Process Co., Inc.—A new pamphlet explains the four processes for concrete curing. They are Hunt clear, "tilt-up", black and pigmented. Also described in this two color fully illustrated pamphlet, are the advantage of Hunt Process Curing, spray equipment necessary, and other helpful curing information.

18 CONCRETE DENSIFIER

Sika Chemical Corporation—The theory and practice of obtaining a good concrete is discussed in the 8-page booklet "Plastiment Concrete Densifier." Beginning with the gel mechanics of cement-water reaction, the booklet tells about the factors affecting cement hydration and basic quality of concrete, also how these factors can be controlled to reduce cracking and increase concrete hardness and impermeability. It is illustrated with drawings, tables, and photographs of engineering projects.

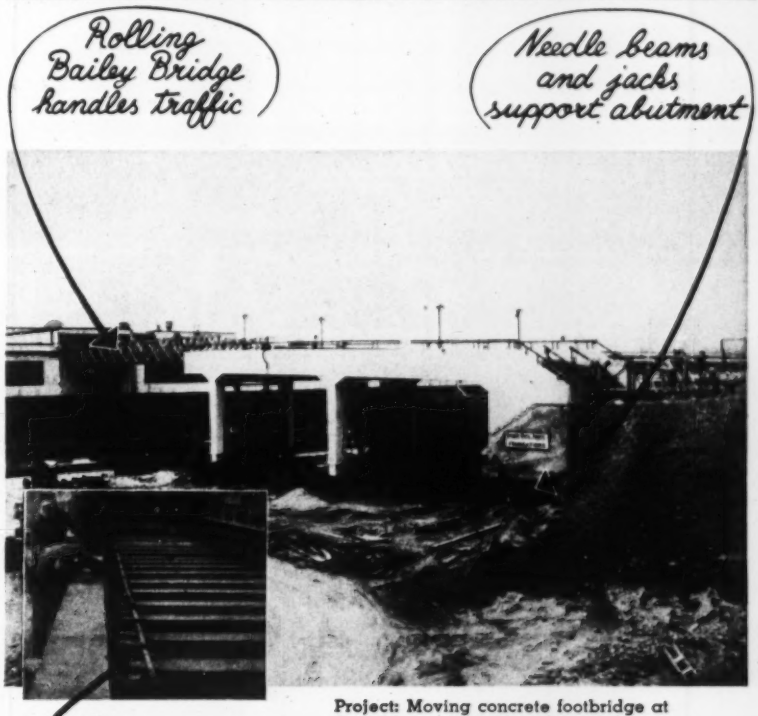
19 CONCRETE EQUIPMENT HANDBOOK

Gar-Bro Manufacturing Company—A 56-page Manual for "Handling and Placing Concrete" is offered. It is a condensed handbook which covers all phases of concrete construction methods from the selection of concrete through the batching and placing procedures. It provides complete check lists of job specifications, job conditions and equipment; lists current technical data; includes many tables; illustrates correct and incorrect placing methods and shows unusual jobs and how they were solved.

20 CONCRETE EQUIPMENT

Whiteman Manufacturing Co.—A copy of a new multi-colored booklet showing Whiteman concrete equipment is now available. Illustrated and described are the Models B-1, J-1 and C-4 Floating Finishing Machines, Models DB-52 and FR-51 Power Buggys, Model M Troweling Machines, Portable Screeding Machines and various Grinding Attachments.

ANOTHER PROBLEM SOLVED BY SPENCER, WHITE & PRENTIS


Rolling Bailey Bridge handles traffic
Needle beams and jacks support abutment
Rollers set between track and runner beams

Project: Moving concrete footbridge at Ford Motor plant, Metuchen, N. J.

General Contractor: Hackart Construction Co., New York City

Architect: Albert Kahn Associates, Detroit

450-TON FOOTBRIDGE MOVED 60 FT. ENDWISE IN LESS THAN 2 HOURS

This moving job—which was necessary to make space for plant expansion—presents several interesting features. One is the rolling Bailey bridge on the overpass, maintaining access to parking lot during the move, and until building of overpass addition.

Another feature was the use of roller-guide channel strips. When pushed against I-beams, these channels aligned rollers perpendicular to the direction of travel, to assure a straight move.

Actual moving of the 450-ton concrete walkway was done —in less than 2 hours—with long-stroke jacks of our own design and manufacture, the jacks by now being veterans of several moving jobs.

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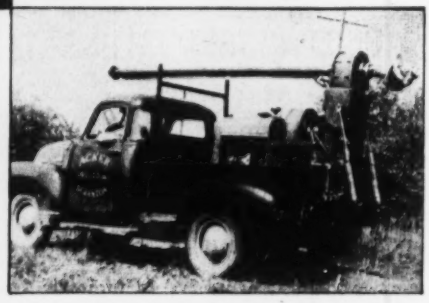
Before you buy any ordinary digger, see and try Acker's brand new "All Purpose" digger. For this compact, portable, moderately priced digger has everything!

New, exclusive patented features result in a more compact, lightweight unit whose speed, capacity and overall operation out-performs many larger, more expensive machines.

For operation in rough terrain, you can dig anywhere a Jeep or small truck can go.

Write today for Bulletin 40–CE



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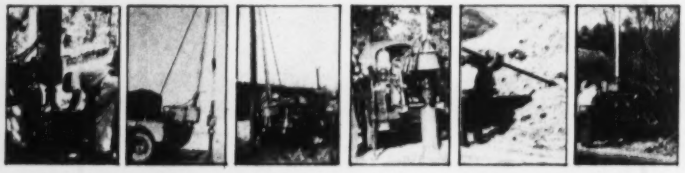

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Compare These Acker Features: PATENTED HYDRAULIC FEED • BUILT-IN HOIST & SHEAVE WHEEL • FINGER-TIP HYDRAULIC CONTROLS • RUGGED ACKER CONSTRUCTION • SPEEDY ONE MAN OPERATION • BUILT-IN REVERSE AND NEUTRAL FULL 360° OPERATING RANGE • PORTABLE, USE IT ANYWHERE COMPACT, MOUNTS ON TRUCK OR JEEP

ACKER DRILL CO., INC. 725 W. Lackawanna Avenue Scranton, Penna.
a complete line of Soil Sampling Tools, Diamond and Shot Core Drills, Drilling Accessories and Equipment

CATALOG DIGESTS

21 CONCRETE FINISHING MACHINES

The Flexible Road Joint Machine Co.—Has issued a new catalog, No. N-14, describing the Flex Plane Bridge & Elevated Highway Concrete Finishing Machines, and why they are essential for mass production of smooth elevated concrete surfaces. Also shown are many examples of the Flex-Plane finisher in action on such projects as the Triborough Bridge, Henry Hudson Parkway and the New Jersey Turnpike Bridge. Details of various methods used for riding the Flex-Plane machine are discussed. Many of the Flex-Plane engineered extras designed to help build finer roads are included.

22 CONCRETE PAVEMENT DESIGN

Portland Cement Association—An 86-page edition simplifies and expedites design procedure for roads and streets carrying all classes of traffic. This manual for the practicing engineer includes design charts for tiebars and dowels, an expanded section on subbases, two pages of joint details and a simplified procedure for determination of "controlling wheel load."

23 CONCRETE PIPES

Cen-Vi-Ro Pipe Corporation—A 23-page, two-color brochure describing Cen-Vi-Ro pipes has just been published. It contains on-the-job photographs and diagrams illustrating applications of Cen-Vi-Ro Pipes. Features of these pipes include rubber gasket joint assembly, great strength, convenient laying and quality and density of concrete.

24 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

25 CONCRETE PIPE HANDBOOK

American Concrete Pipe Association—This handbook contains 384 pages on the manufacture and use of concrete and reinforced concrete sewer and culvert pipe. Discussion of Marston's Theory and maximum and minimum allowable depths of fill is presented along with examples and tables. Useful hydraulic data and information on jacking pipe lines is given. A thorough, comprehensive discussion of the use of concrete pipe in sewers and culverts is included. Appendix contains A.S.-T.M. and AASHO specifications. Price $4.00.

N. B. There is a charge for this book. Make checks payable to The American Concrete Pipe Association.

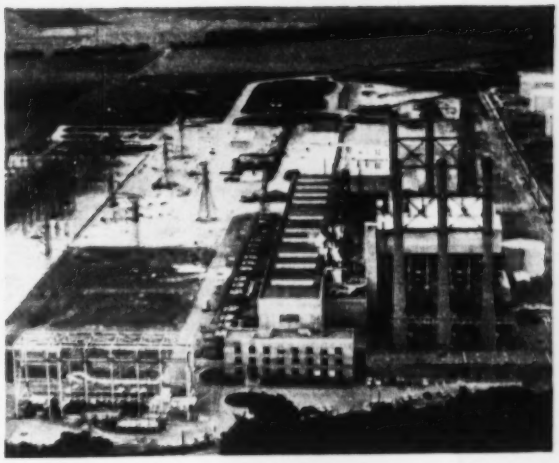
26 CONCRETE PRESSURE PIPE STORY

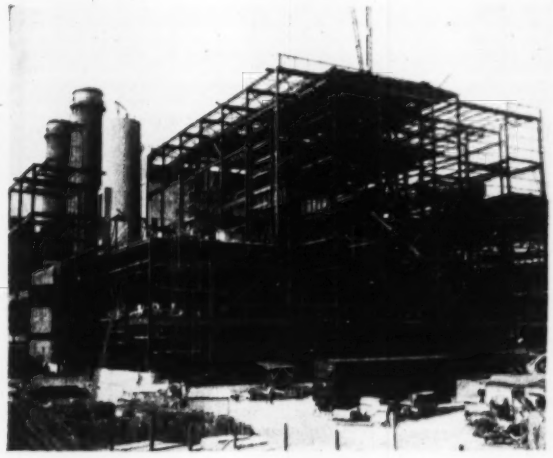
Price Brothers Company—Offers a new 24-page booklet "The Story of Concrete Pressure Pipe" that explains manufacturing, prestressing, laying and tapping of concrete pressure pipe. Contains catalog of types of Price Pipe, list of specials and information on the flexible, watertight joint. Factual, illustrated book valuable for engineer, contractor and layman.

Four New Power Stations

MOSS LANDING, CALIFORNIA

One of the West Coast's biggest generating plants is Pacific Gas and Electric's 575-mw steam plant on Monterey Bay. Bethlehem Pacific Coast Steel Corporation fabricated and erected the steelwork, and fabricated the switching structures and transmission towers shown here.



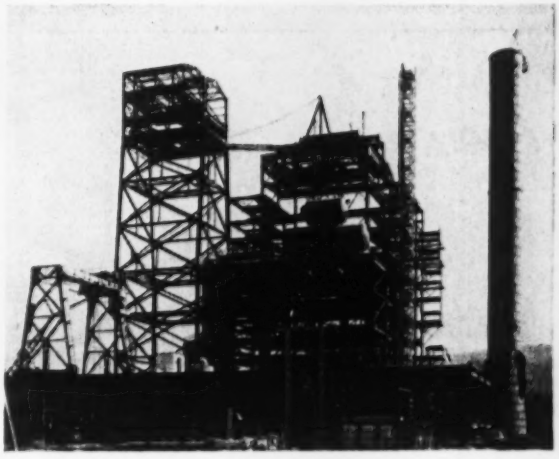


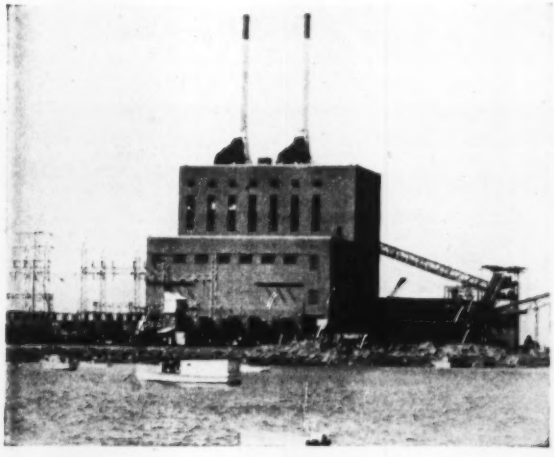
ALEXANDRIA, VIRGINIA

Back in 1948, Bethlehem fabricated and erected 3800 tons of steelwork for Potomac Electric's 160-mw steam-electric plant. Greatly increased power requirements have since made it necessary to construct this 3500-ton addition, to house two new 100-mw units. Final capacity will total 360 mw.

MARTINS CREEK, PENNSYLVANIA

Pennsylvania Power and Light's new 132.5-mw outdoor plant on the Delaware River was designed to operate only 3,000 to 4,000 hours per year, handling peak loads. Investment was minimized by such economies as eliminating housings for much of the equipment, leaving exposed a good deal of the 2300-ton steel framework. A second unit is under construction.





DUNKIRK, NEW YORK

Niagara Mohawk's ultra-modern steam-electric generating station on Lake Erie. The steam turbine of each of the two 80-mw units is of a new design, first of its type ever made. Over 5000 tons of steel, fabricated and erected by Bethlehem Steel Company, went into the station's structural framework and boiler supports.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

THIS IS NO "BULL!"

"Flexibles" really solve sewer-cleaning problems!

Mexico City has a unique and serious sewer problem. Due to the settling of a large portion of the city, it is now approximately 20 feet lower than its sewer outlet, the Grand Canal. Until the condition is corrected and normal flow restored, there is a continuing problem of removing solids from the sewers, some of which are more than 300 years old. As a solution, the city has purchased over 200 "Flexible" Bucket Machines—one of which is pictured. Mexico City endorses "Flexibles" for their efficient performance and ease of operation and maintenance. We invite the opportunity to give your city an "on the job demonstration."

Write for our **FREE** *Catalog*

Flexible SALES CORPORATION

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AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

Easy. . **to handle**
to drive
to locate . . .
and they're permanent!

The *New* **Copperweld** TRADE MARK *Non-Rusting*

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A thick copper covering prevents corrosion, while the steel core provides strength and rigidity for easy driving. The Copperweld Molten-Welding process makes the two metals inseparable.

**Trade Mark*

At little cost, Copperweld* Survey Markers protect the investment of the original survey. They can't rust or rot, and they're simple to install—won't splinter or break. The bronze head can be readily center punched for precise reference. Want more details on this economical method for identifying survey points permanently? Write for Bulletin No. 144.

Standard length is 3 feet—other sizes made to order. Packed 10 markers to a carton.

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THE *Finest*

TRACING CLOTH

Imperial is known in drafting rooms all over the world as the traditional quality tracing cloth.

With the background of decades of experience, its makers have pioneered in modern improvements to maintain Imperial as the finest tracing cloth made.

27 CONCRETE SAWS

Eveready Briksaw Company—Prices and specifications on all Eveready products are given in the new folder No. 102. This includes Masonry Saws, Concrete Saws, Blades for the saws—Diamond, Abrasive, and Break-Resistant Abrasive—and a Dust Control Unit for use when cutting dry with the masonry saw. A special feature is a blade recommendation chart, showing the correct Eveready Blade to use on each type of masonry material.
Further information on Eveready products can be obtained from any authorized dealer, or from Eveready Briksaw Co., 1509 S. Michigan Blvd., Chicago 5, Ill.

28 CONCRETE SAWS AND BLADES

Clipper Manufacturing Company—The latest price list put out by Clipper Manufacturing Co. includes specifications on Clipper Saws and Blades such as Masonry Saws, Accessories, Diamond Blades, Abrasive Blades, and Coin Saws. Also given are the 25 direct factory branches. Form 246 describes the two newest concrete saws, Models C-250 and C-146. Clipper's Joint Sealing Machine, Model AC-40 is also covered in detail.

29 CONCRETE VIBRATING EQUIPMENT

Viber Co.—Has put out a new pamphlet entitled, "How to Apply, Operate and Maintain External Vibrators in the Manufacture of Concrete Pipe." This pamphlet explains why external vibration should be used and the application of Viber PX 7 & PX 8 model pneumatic external vibrators. Other topics covered are operation specifications, design and construction, complete assembly, clamping arrangement, and maintenance.

30 CONCRETOR SLIPFORM EQUIPMENT CATALOG

B. M. Heede, Inc.—A 32-page catalog with 41 pictures and drawings giving a detailed account of the hydraulic system of slipform raising. It covers various applications of slipform such as apartment houses, silos—singular and multiple, bridge pillars, factory buildings, water towers, pithead buildings, mine shafts, etc. Inserts and editorial reprints on water tower construction equipment are available on rental basis.

31 CONSERVATION EQUIPMENT

Allis-Chalmers Manufacturing Company—A 12-page two-color catalog to tell how modern industrial power equipment fits into the farm conservation scene to help in land clearing and land reclamation, earthmoving for irrigation and drainage, terrace and diversion channel construction, pond and reservoir building and other jobs requiring power and versatility of crawler tractors, motor graders or scrapers. On-the-job photos of the equipment graphically illustrate the equipment in action.

Turn to page 100 and order your literature.

32 CRANE RAILS AND FASTENINGS

United States Steel Corporation—A 12-page booklet, ADV-19803, containing illustrations and descriptions of three special crane rail sections and their accessories, such as joint bars, bolts, nuts, spring washers and rail clamps designed especially for heavy duty service. Physical properties of the rail sections are listed in addition to drawings and specifications of the rails and their accessories. Recommendations for correct installation, together with a sample 250' crane rail layout are fully explained.

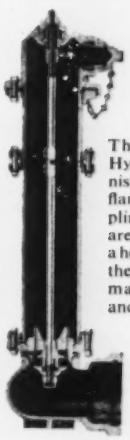
33 DESIGN EXTRACTS—SHEET PILING

United States Steel Corporation—A 50-page book ADV-18605, contains comprehensive design data concerning steel sheet piling. The material in this book was taken from the publication "Carnegie Steel Sheet Piling," which, when first published during the early 1930's, was one of the first handbooks available on the subject.

Return the coupon today!

Solidly Built

The R. D. Wood Swivel Joint Hydrant is designed to provide maximum reliability at lowest cost consistent with assured delivery of water at full pressure. It is solidly built and of the finest materials. Every point where rust and corrosion might interfere with operation is protected by at least one bronze surface.



The R. D. Wood Hydrant can be furnished with breakable flange and stem coupling at extra cost. Both are built to break with a heavy blow. This saves the hydrant itself and makes repair quick and easy.

The R. D. Wood Swivel Joint Hydrant: All internal parts, including drain valve seat, removable through barrel • all-bronze stuffing box • completely revolving head • compression-type valve, cone shaped to prevent water hammer • automatic drain valve • bronze main valve seat screws directly into elbow with straight, not tapered threads • mechanical-joint pipe connections if specified.

R. D. Wood Swivel Joint Hydrants

Public Ledger Building, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

CATALOG DIGESTS

34 DIESEL EQUIPMENT

Caterpillar Tractor Co.—Machines that are capable of handling a variety of jobs all-year round and still are capable of emergency snow removal when storms strike is the main point of the pamphlet "Clearing the Way—to Lower Costs." The versatility of such machines as the Cat #12 Motor Grader, Cat D6 Tractor and attachments such as HT4 Shovels and Bulldozers, Snow Wings, Snow Blowers, Snow Plows, etc., is discussed and illustrated.

35 DIESEL-POWERED TRACTOR

Allis-Chalmers Manufacturing Company—A 28-page, three-color illustrated catalog on the HD-20 Diesel-powered hydraulic torque converter drive crawler tractor. Included is a three-page cutaway picture of the HD-20 showing exclusive features of the tractor, and detailed description of the 175 net horsepower Diesel engine. Allied equipment line is listed and operating features and service advantages discussed.

36 DRAFTING MACHINES

V. & E. Manufacturing Co.—Has issued a new 15-page brochure giving detailed descriptions of such drafting machines as the Vertical Drafter, Detail Drafter, Left-Handed Drafter, and Formed & Solid Drafting Machine Scales. Information on how to select the proper size machine will be helpful to engineers and draftsmen. Also included is a price list.

37 DRAWING INSTRUMENTS

V. & E. Manufacturing Co.—Has published a booklet describing their various drawing instruments and drawing sets. Among the instruments included are Open-Truss Compasses, Drop Bow Compasses, Friction Dividers, Vemco Velox Beam Compasses, Erasers, and Drawing Leads. A price list is also given.

38 DRILLING

Sprague & Henwood—An eight-page two-color bulletin contains more information regarding the Model 142, a high-speed heavy-duty drilling machine, than has heretofore been available in type. Besides a detailed illustrated description of the Model 142, together with complete specifications and working data, this new bulletin lists the many items of accessory equipment required for successful core drilling. Bulletin No. 150 will be mailed promptly on request without charge or obligation.

39 DRAG SCRAPERS FOR TRACTORS & CRANES

Sauerman Bros., Inc.—Field Report 209 shows how a scraper powered by a two-drum hoist mounted on a tractor can work in places which allow none of the head room or surfaces other machines require. Describes clean-outs under culverts, bridges and along rivers. Field Report 219 shows how to make a boom machine reach farther and dig more. In general, a Crescent scraper 50% larger than the regular bucket may be used.

40 DUSTPROOF INSTRUMENTS

Charles Bruning Company, Inc.—Offers a colorful bulletin on its wide line of dustproof, ballbearing instruments. The instruments discussed range from telescopes to pencils. They offer lasting accuracy without frequent overhaul, adjustment, and repair expense.

41 EFFECTS OF CALCIUM CHLORIDE

Solvay Process Div., Allied Chemical & Dye Corp.—Has prepared a 40-page, semi-technical booklet of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air-entraining, high early strength and low heat cements.

42 ELECTRIFIED EQUIPMENT

General Electric Company—Bulletin GEA-5541, "Progressive Constructors Demand Electrified Equipment" is now available. Various installations of G-E electrified "tools" are shown, and the 9 main reasons why electrified construction tools are returning profits is gone into.

43 ELECTRIFIED EQUIPMENT

General Electric Company—Offers bulletin GEA-6195, "Electric Equipment for Heavy Construction Tools." This describes how G-E equipment helps give your construction tools safer, smoother, easier operation, greater precision and efficiency, more portability, increased flexibility, lower production cost, and lower maintenance costs.

DON'T

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TO SEND IN

YOUR COUPON

BEFORE

THE DEADLINE

44 ELEVATING SCRAPER

Hancock Soil Conservation Equipment—Offers an interesting new pamphlet on the Hancock self-loading elevating scraper and its many uses. Included in this pamphlet are on-the-job photographs, showing the scraper in action, as well as the different specifications of the scraper.

45 ENGINEERING TEXTBOOKS AND REFERENCES

The Ronald Press Company—Described in a special brochure is a selected list of current technical books of special interest to the engineer. These authoritative and up-to-date references and textbooks cover many important aspects of structural analysis, design, model testing, and management.

46 ENGINEERS TRANSITS

David White Co.—Has available without charge bulletin #1052 showing a complete line of engineers transits and other precision instruments, complete with price list.

47 FACILITIES AND PRODUCTS

Newport News Shipbuilding and Dry Dock Co.—A 42-page, two-color booklet illustrates the great variety of heavy industrial equipment produced by the company, and the wide range of facilities used to produce them. This booklet is of particular interest to concerns seeking appropriate facilities for the production of heavy industrial equipment.

48 FIRE PUMPS

Economy Pumps, Inc., Div. of C. H. Wheeler Mfg. Co.—An illustrated folder containing capacities of fire, booster and tank pumps is offered. Dimension charts are included along with typical specifications as a guide to the selection of Fire Pumps. Shown also are some typical fire pump installations.

49 FLOOR GRATINGS

Borden Metal Products Co.—A catalog containing technical information on how to select, design, purchase and install floor gratings, safety steps, floor armor is offered. Safeload tables, step-by-step procedure for ordering, planning and checking, etc., is included.

50 FLUORIDATION

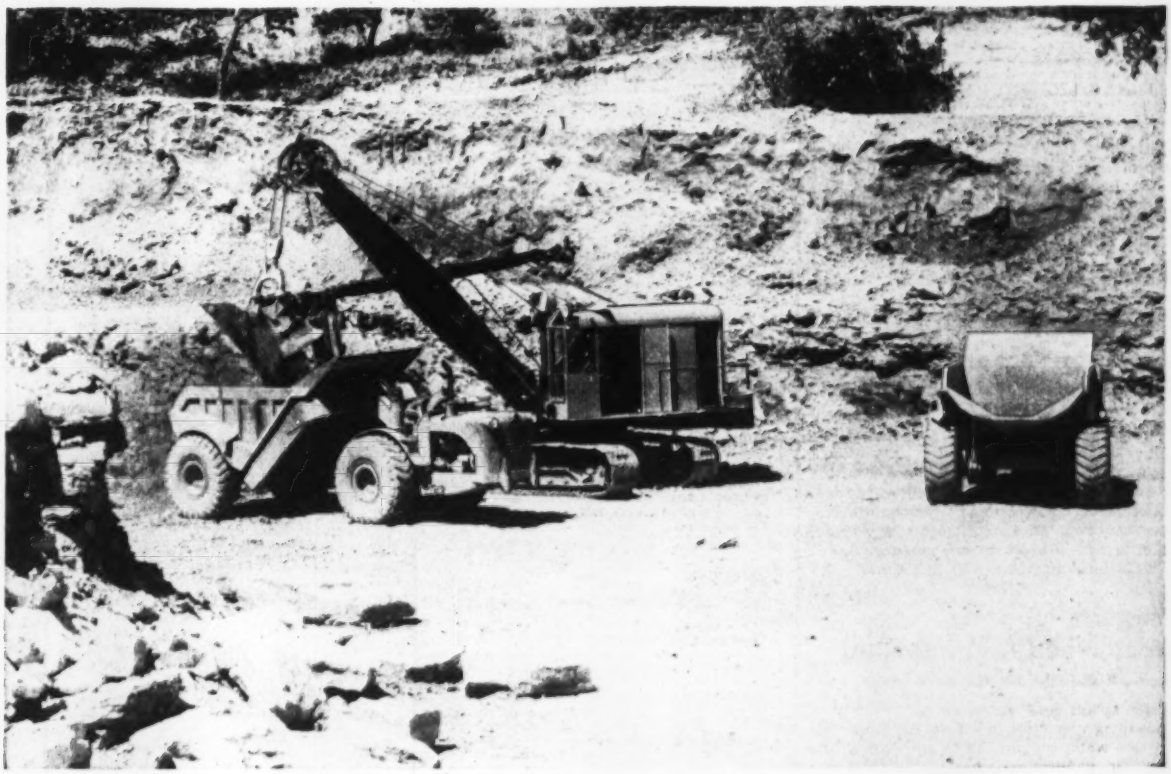
%Proportioneers, Inc.%—Bulletin SAN-9 gives the complete story on the feeding of fluorides for the reduction of dental caries. It explains the methods of feeding sodium silico-fluoride and hydrofluoric acid under pressure. Special attention is given to the accurate control of feeding in strict proportion to the flow. Equipment is described for feeding into pressure line.

51 FOREIGN SERVICE LIFE INSURANCE

Smith and Sternau—Full details will be furnished on how A.S.C.E. members, who work on foreign projects, can fully protect their wives and children at minimum rates. In addition to occupation, give date of birth and citizenship, also whether serviceman or civilian.

52 FOUNDATIONS

Drilled-In Caisson Corporation—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.



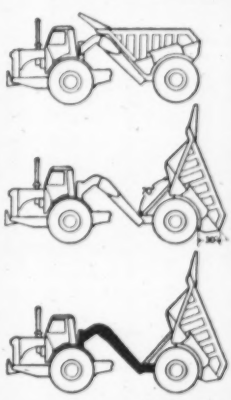
Four TR-200's work up to 460 hours a month . . . average only 4 hours down time

In less than a year, the George W. Kerford Quarry Company, Atchison, Kansas, put 3,828 hours of work time on each of their four Allis-Chalmers TR-200 Rock Wagons. They piled up 460 hours a month over one five-month period. During the year, service down time for each unit averaged only 4 hours a month . . . this means that each rock wagon was on the job over 98 percent of working time!

The TR-200's have been hauling quarry stone from the pit to a crushing plant 1½ miles away. Loads average 16 tons and each cycle is completed in 14 min. Fuel consumption has been about 3¼ gal per hour with no oil needed between changes.

George E. Kerford states, "We like the TR's maneuverability and easy control, which makes it possible for any good truck driver to learn to drive the outfit quickly. The wagon body is well constructed and cleans easily and completely. We find that most parts needing frequent maintenance and repair are easily accessible."

HERE ARE THE FEATURES BEHIND THIS OUTSTANDING RECORD



Big bowl top makes excellent target for shovel or dragline operator, helps loading under bins or chutes.

High power-to-load ratio of 16 hp per yard of capacity speeds hauling, helps on steep grades.

Maximum lift angle of 70 degrees speeds dumping of any type material. Big opening and "bathtub" design slide loads out fast at minimum dump angles.

Dumps 30 in. back of rear wheels to put entire load over banks or into hoppers.

Wheel base stays fixed during dumping cycle for greater safety on banks, accuracy in spotting loads.

Four-wheel air brakes allow full control, safer dumping over banks.

Hydraulic control system raises or lowers bowl while traveling, gets TR-200 into position sooner.

176 hp engine — 5 speeds forward to 21.6 mph, reverse 2.5 — 11 yd struck, 15 yd heaped, 18 tons

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The Flood Control Controversy

LUNA B. LEOPOLD, *U.S. Geological Survey;* THOMAS MADDOCK, Jr., *U.S. Bureau of Reclamation*

This new book offers an objective view of the major technical, economic, and political issues involved in big dams, little dams, land management, and the planning of a realistic flood control program. A Conservation Foundation Study. *"The most important book yet in its field."* Journal of Soil and Water Conservation. *278 pp., 31 ills., tables.* $5

Fresh Water From the Ocean

CECIL B. ELLIS *and Staff Members, Nuclear Development Associates, Inc.*

Thoroughly investigates economic feasibility and underlying scientific principles of extracting fresh water from the ocean on the basis of gaining 1000 million gallons per day. Covers plant construction, power requirements, raw materials, etc. A Conservation Foundation Study. *"An uncommonly interesting book."* Scientific American. *217 pp., 42 ills.* $5

Vegetation and Watershed Management

E. A. COLMAN, *U.S. Forest Service*

First systematic appraisal of methods of managing vegetation in watersheds to increase ground water supplies, check soil erosion and siltation, and reduce flood peaks. A Conservation Foundation Study. *"A timely and authoritative contribution to our knowledge."* The Scientific Monthly. *412 pp., 24 ills., 6 maps.* $7

Structural Design in Reinforced Concrete

CLIFFORD D. WILLIAMS, *Patchen & Zimmerman;* CHARLES E. CUTTS, *University of Florida*

New. Full coverage of essentials of modern reinforced concrete design. Special attention given to prestressed concrete, design for ultimate stress, design of circular tanks, compression and bending in two directions. *308 pp., 195 ills., 16 tables.* $6

Highway Engineering

L. J. RITTER, Jr., *University of Florida;* R. J. PAQUETTE, *Georgia Institute of Technology*

Parallels actual sequence of factors in construction of roads and highways. Covers rural highway, city street, airport construction; soil and drainage, contracts, costs, financing, supervision, etc. *721 pp., 194 ills., 66 tables.* $7.50

Statically Indeterminate Structures

PAUL ANDERSEN, *University of Minnesota*

Structural analysis and design are directly associated in this comprehensive book. Numerical applications of actual design problems included as integral part of the explanations. Discusses cofferdams, culverts, crane columns, knee-braced structures, etc. *305 ills., 65 tables.* $7.50

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CATALOG DIGESTS

53 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc.—Has literature on the construction of difficult and unusual foundations, description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations; Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

54 GASOLINE HAMMER

Barco Manufacturing Co.—Offers an eight-page catalog showing the complete selection of Barco Gasoline Hammers and their many uses. Also shown are the accessories for Barco Gasoline Drillers and Hammers, such as the asphalt cutter, tamper, chisel, ground rod driving chuck, drill, frost wedge, spade, digging tools, moil point, gad and sheathing driver with shank.

55 GATES CONTROL WATER LEVELS

Thompson Pipe & Steel Company—A bulletin shows how two new, simple automatic gates control and maintain accurate water levels either above or below gates for streams and canals, water and sewage plants and other open-channel uses. New design principle—no sheaves, ropes or floats. A third device maintains uniform discharge with varying head on upstream side. Bulletin illustrates many typical uses to save water, lower maintenance costs and eliminate flood damage.

56 GEARS AND OPERATING MACHINERY

The Earle Gear & Machine Co.—Bulletin describes products, facilities and designing services; gears of all types in all practical materials; other products closely related to the manufacture of gears, such as racks, sprockets, sheaves and special machinery of which gears form a part. Also includes a table of gear formulas with related blue print references; ordering information and a few installation photos to illustrate the wide applications of products.

There are 159 Digest items on pages numbered 100 to 126. Read all items for the literature of interest to you.

57 GENERAL CATALOG

Bucyrus-Erie Company—Now offers a new edition of their general catalog (GC-5A), which describes their complete line of excavating, drilling and material handling equipment. The 70-page, 2-color catalog, designed for quick reading, features over 100 field action photographs. Several recent additions to the company's line of products are included in sections entitled Quarry and Mine Shovels and Blast Hole Drills; Stripping Shovels; Walking Draglines; and Railway Cranes (including a 250-ton diesel-electric crane). Other sections describe small machines (3/8 to 4 cu. yd. capacity); the all-hydraulic Hydrocrane; Water Well, Drills, and Oil Well Spudders.

58 GRATING FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Just published its new Catalog F400, containing illustrations, descriptions and complete engineering data on grating flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial and power plants and refinery walkways, stairways, driveways, trucking aisles, etc.

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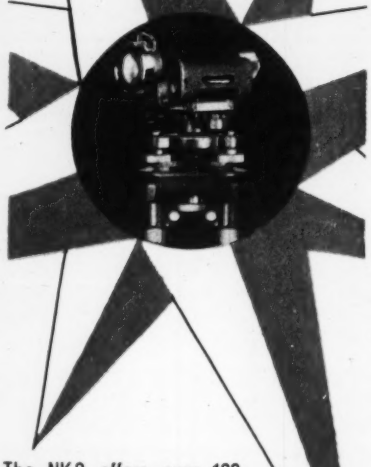

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Restoration of badly deteriorated concrete was a major item in the general renovation of 30-year-old Busch Stadium, home of the St. Louis Cardinals.

Western mechanics tested all concrete for soundness. Disintegrated area in columns, ramps, floor beams and soffits were cut out, sand-blasted, reinforced and refilled with gun-applied concrete.

Weak columns were strengthened by wrapping with additional reinforcement and covering with a layer of gun-applied concrete.

Underside of the ramps was also reinforced and built back to original strength.

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By the late LAURENCE I. HEWES, *formerly of the U. S. Bureau of Public Roads;* and CLARKSON H. OGLESBY, *Stanford University*

A broad but dynamic study, and a highly practical guide to highway technology in America today. *Highway Engineering* is an invaluable reference and source of fresh material for any professional man who works in the planning, design, construction, maintenance or operation of our nation's highway and street system. Completely up to date, this work summarizes the latest developments and critically analyzes the many problems which remain unsolved.

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MATERIALS OF CONSTRUCTION

by M. O. WITHEY and G. W. WASHA, *both of the Univ. of Wisconsin*

Here, in a single volume, is a practical, time-saving reference on the mechanical properties and uses of engineering materials. Latest data on sources, manufacture, and fabrication of the principal materials are presented. Causes of defects and variations, and how they may be discovered, are discussed in simple terms. Ample references.

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By HARRY PARKER and JOHN W. MacGUIRE, *both of the Univ. of Penna.*

The only work entirely devoted to solving surveying and grading problems in site engineering. It reviews the trigonometry and logarithms used, and shows how these time-savers can help you plan a building site quickly and accurately. All needed tables are given and typical logarithmic problems are worked out in detail.

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WATER SUPPLY and WASTE-WATER DISPOSAL

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Set forth here for the first time are many of the important advances toward reducing water sanitation to an orderly process of calculation. The first half of the book deals with collection and distribution; the second half details the treatment of water.

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59 GRAVITY FILTERS

The Permutit Company—A 24-page Bulletin, 253AA should be of interest to all operating, consulting and architectural engineers dealing with water problems. It shows the complete line of rapid-type gravity filters, which are made in three basic types of concrete, of steel and of wood. Specifications, operating characteristics, outline dimensions and typical installations of these filters and associated accessories have been included.

60 GUNITE

Pressure Concrete Company—Has a 48-page illustrated, free booklet on Gunite in all of its phases. The booklet contains specifications, job stories, and illustrations showing Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on new prestressed tank construction and much other data. A new leaflet just published illustrates pressure grouting to dams.

61 HAND LEVER DRILLS

Acker Drill Co., Inc.—Acker Bulletin 21 describes both Acker LD and LLD hand lever feed core drills for foundation test drilling, highway test cores, moderate depth mineral prospecting, etc. Write Acker Drill Co., Inc., Scranton, Pa.

62 HEADS

Commercial Shearing and Stamping Company—Presents a two-color 29-page catalog (P-2) called Products for Boiler and Tank Manufacture. Contained are informative charts, tables, photographs, and diagrams. This catalog is a complete treatise of the many styles of heads manufactured.

63 HEAVY DUTY MOTOR OILS

Standard Oil Company (Indiana)—A 12-page illustrated booklet covering the history and development of Standard's heavy-duty motor oils is available. This bulletin reviews the performance requirements of heavy duty motor oils and defines the new A.P.I. service classifications.

64 HIGH STRENGTH CORROSION-RESISTING STEEL

Bethlehem Steel Company—The use of high strength, low-alloy steel is rapidly increasing in practically every branch of industry. In a 66-page catalog, "Mayari R—Bethlehem's High Strength Corrosion Resisting Steel," the properties and outstanding features of this steel are described. Included also are many photographs illustrating its use in equipment for the construction industry; in bridges, pipe and penstocks; and in mining, transportation, and other industrial fields.

65 HIGHWAY BRIDGE BOOKS

American Association of State Highway Officials—Offers a two-volume edition, "Public Roads of the Past," Volume I, and "Historic American Highways," Volume II, of the history of roads, methods, instruments and influences. Both volumes have complete bibliographies, illustrated with both maps and sketches. Volume I, the European phase, from earliest recorded history (about 3500 B.C.) thru rise and fall of Roman Empire, discovery of New World, to 1800. Volume II, is the record of transportation development in America. Price is $3.00 for Volume I and $4.00 for Volume II, or $6.00 per set.

N. B. There is a charge for these books. Make checks payable to American Association of State Highway Officials.

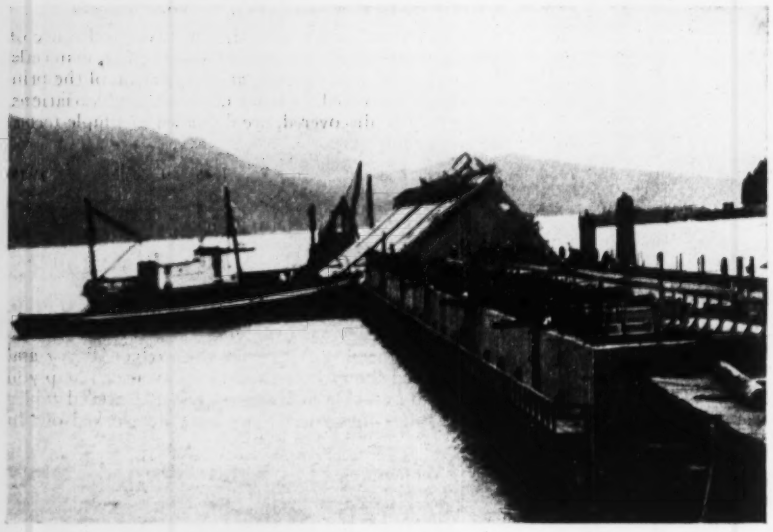
66 HYDRAULIC CRANE

Austin-Western Co.—An 8-page catalog, AD-2206RI, pictures and describes the new Austin-Western Hydraulic Crane. This tractor-mounted crane, with its pickup, carrying, and placement capabilities, combines the best features of crawler, truck, and erection cranes with those of industrial shop cranes. All movements are actuated by fast, smooth, hydraulic control.

67 HYDRAULIC DATA BOOK

Leupold & Stevens Instruments, Inc.—Interpretive data on water measurement and control is at your fingertips in the 144-page revised edition, in three parts: Float Wells and Instrument Shelters; Errors in Float Operated Devices; Hydraulic Tables; plus pages for notes and memorandums. Indispensable for the engineer with its wealth of information, tables, charts and illustrations. The price is $1.00.

N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instruments, Inc.



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This unique ore-loading wharf designed in Plastiment-concrete by Frederic R. Harris, Inc., Consulting Engineers of New York, for the Aluminum Company of Canada's gigantic Kitimat project, was cast on its side, floated into place and tilted 90° into final position.

Floating Plastiment-concrete structures are not new. . . . Of the seven American projects featured as Famous Floating Concrete Structures in the May issue of the Journal of the American Concrete Institute, five were constructed of Plastiment-concrete . . . most of the foreign jobs shown also contained Plastiment, supplied from the fourteen overseas Sika manufacturing organizations.

While you may not be designing a floating concrete pier, the special qualities that made this concrete denser, more uniform, and more resistant to cracking and abrasion are undoubtedly a must in your own construction projects. Performance has proven that Plastiment can help you attain this goal.

For the story on the Kitimat project, plus a detailed explanation of Plastiment's exclusive action on cement gels, write for your copy of Sika Job 14 and the illustrated brochure "PLASTIMENT CONCRETE DENSIFIER." Our Engineering Department will be glad to tell you how Plastiment can help you on your present job.

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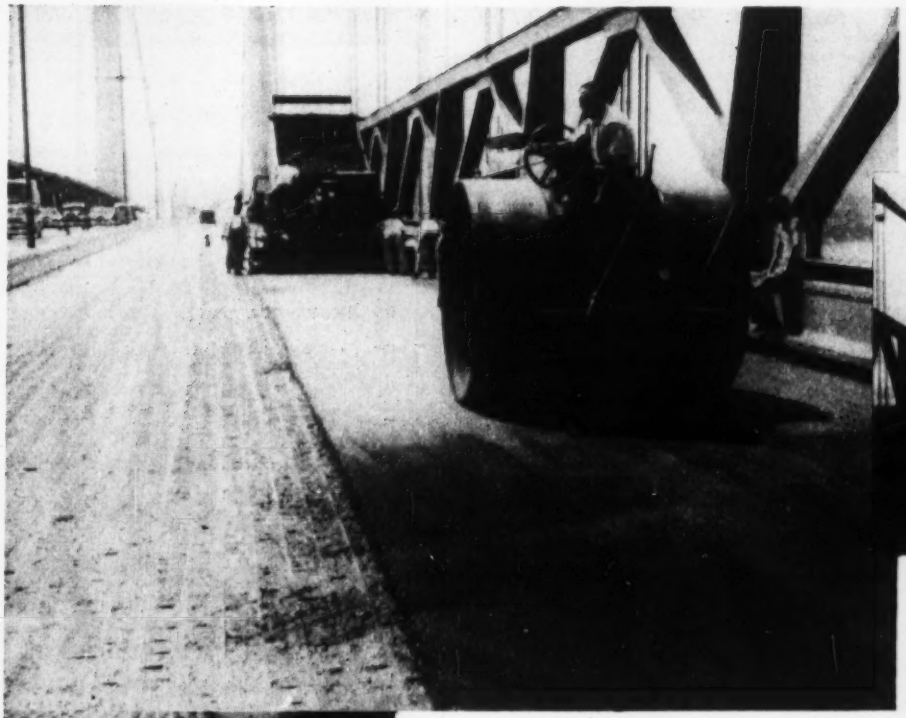
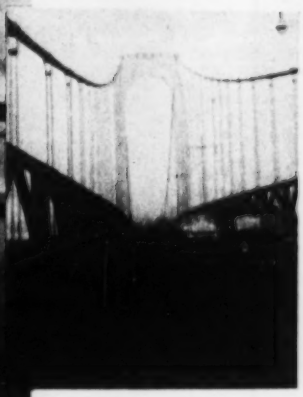


Laying hot-mix Texaco Asphaltic Concrete pavement on New York City's Bronx-Whitestone Bridge, which is under jurisdiction of Triborough Bridge & Tunnel Authority.



Asphalt contractor—Standard Bitulithic Company, Mount Vernon, N.Y.

Asphalt consultant for Triborough Bridge & Tunnel Authority—E. D. Sabin

Close-up of exposed steel grid in bridge floor and the new Texaco Asphaltic Concrete wearing surface.

Spreading seal coat of asphalt-treated stone dust while the asphalt pavement was being rolled.

Traffic will average 75,000 vehicles a day on this resilient Texaco Asphalt pavement

The Bronx-Whitestone Bridge links two of New York City's five boroughs, Bronx and Queens. More than 23,800,000 vehicles crossed the bridge last year, a daily average of 65,000, with a 24-hour peak of 114,000 cars and trucks.

During July of this year, a hot-mix Texaco Asphaltic Concrete wearing surface was constructed on this bridge. Careful planning of working hours resulted in a minimum of inconvenience to traffic. Prior to laying the new asphalt surface, the existing pavement was chipped off down to the steel grid in the bridge floor, as shown by the photos. The resilient asphaltic concrete surface was then laid to a compacted thickness of $1^1/_2$ inches.

It was essential that the new pavement be opened to traffic immediately after it had been rolled. Application of a seal coat of asphalt-coated stone dust during the rolling operation eliminated any tackiness.

The answer to your own paving problem may be a heavy-duty pavement of the hot-mix Texaco Asphaltic Concrete type, or it may be one of the low-cost Texaco Asphalt surfaces designed for secondary roads and streets. Texaco Asphalt Cements, Cutback Asphalts and Slow-Curing Asphaltic Oils offer the road builder a variety of answers to the paving problem. Helpful information regarding all of these types is supplied in two booklets which you can obtain without obligation by writing our nearest office.

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TEXACO

REG. T. M.

TEXACO ASPHALT

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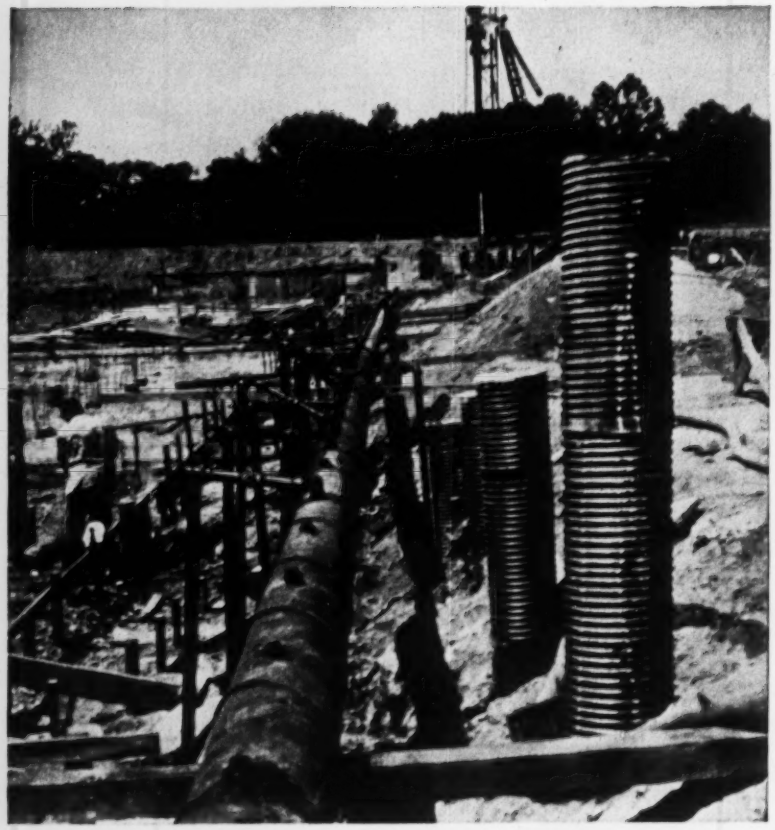

For getting rid of unwanted water on construction jobs, more and more contractors are turning to Naylor light-weight pipe. The wellpoint system illustrated here shows Naylor pipe in action, getting rid of surplus water. The distinctive, light-weight structure of Naylor pipe and its characteristic extra-strength and safety have made it outstanding for handling high and low pressure air and water on all types of construction. Sizes range from 4" to 30" in diameter with all types of fittings and connections. Write for Bulletin No. 507.

NAYLOR PIPE

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Eastern U.S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

CATALOG DIGESTS

68 HYDRAULIC PROJECTS

The Master Builders Co.—A 48-page booklet on dams, power houses and tunnels shows pictures of the structures, located in various countries in North and South America and Japan. It gives concrete test data, and describes interesting concrete problems and how they were solved.

69 INCINERATOR STOKERS

Flynn and Emrich Company—Bulletin No. 1701 fully describes a proven design of automatic stokers for municipal and industrial incinerators. The bulletin clearly shows the design and operation of this simple, rugged and dependable incinerator stoker that has proven itself in the field.

70 INCOME PROTECTION FOR MEMBERS

Smith & Sternau—A pamphlet giving full details on the societies' groups disability plan outlines the moderate rate and its many advantages and benefits. Specify membership grade on coupon.

71 INDUSTRIAL PRODUCTS

Johns-Manville—A new edition of their 40-page Industrial Products Catalog which offers essential data on the following groups of products: Insulations, Refractory Products, Asbestos Cement Pipe, Packings, Gaskets, Electrical Products, Frictional Materials, Roofing, Siding, Flooring, Partitions, and Ceilings. Photographs, diagrams, and text have been revised and brought up-to-date so that engineers and plant executives will have the latest information in a compact catalog that is easy to use.

72 INSULATION

Pittsburgh Corning Corporation—Offers a 24-page booklet describing Foamglas, a stay dry, long-life insulation which may be used for industrial, commercial, and public buildings. Fully illustrated in color, the booklet contains the many features and diversified applications of this new type thermal insulation. Also included are informative charts, diagrams and technical data.

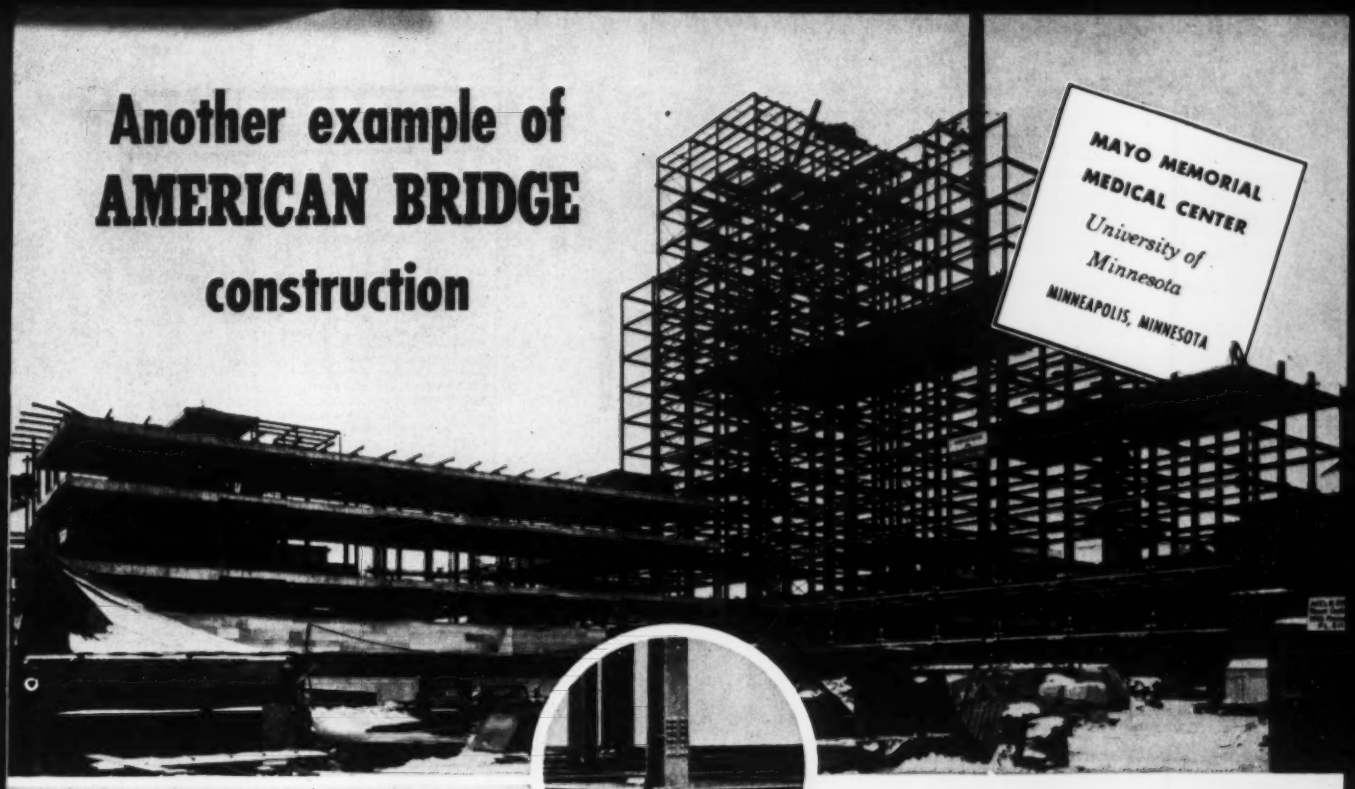
73 JOINT SEALER

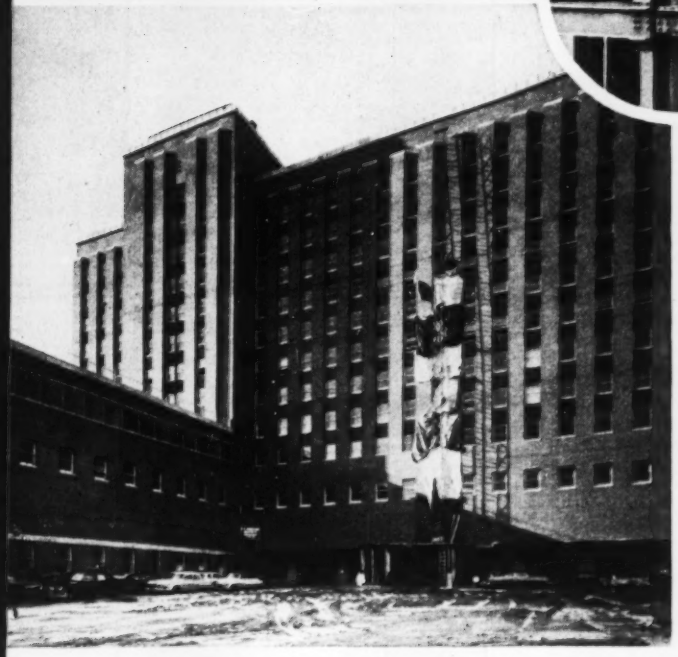
Sika Chemical Corporation—A 4-page brochure illustrates advantages and uses of Igas Joint Sealer, the non-meltable mastic water stop which is installed after concreting. Information is given on how to seal joints between concrete, steel, ceramic and other construction materials. Sketches and instructions show how Igas joints are installed on or opposite the side of the structure (buildings, tanks, tunnels, etc.) exposed to water pressures.

74 KODAGRAPH REPRODUCTION MATERIALS

Eastman Kodak Company—Up-to-date data and information on the characteristics of Kodagraph reproduction materials are provided by a new edition of the Eastman Kodak Company's publication, "Modern Drawing and Document Reproduction." New sections on Kodagraph Projection Positive Paper and Kodagraph Microprint Paper have been added to the booklet. The latest data on sheet sizes, roll sizes, and packings has also been incorporated for all products covered. Provides basic information on Kodak reproduction materials for use in engineering, industrial, and other fields.

Another example of AMERICAN BRIDGE construction





Field connections on 2,300-ton steel framework made with high-strength bolts!

● The University of Minnesota's imposing new Mayo Memorial Medical Center, in Minneapolis, is one of the largest steel frame structures erected with high-strength bolts for field connections.

2,300 tons of structural steel—all of it fabricated and erected by American Bridge—went into the framework of the building. The project consisted of an auditorium approximately 100′ x 125′; an east wing six stories high, approximately 50′ x 250′; a south wing six stories high, approximately 50′ x 140′; and a fourteen-story tower section, approximately 50′ x 250′.

The successful use of high-strength bolts on a building of this size makes a good case for the soundness of this type of construction. American Bridge crewmen can make strong, tight connections with high-strength bolts as efficiently and speedily as less skilled personnel can handle the more common methods.

Another factor favoring the use of bolted connections is the reduction of construction noise. And this advantage creates considerable goodwill when erecting in business, hospital and educational areas.

But American Bridge plays no favorites when it comes to methods of making connections. Whether specifications call for riveted, welded or bolted construction, you can depend on American Bridge to handle the job with maximum efficiency, economy and speed—anytime, anywhere! For detailed information regarding your requirements, please contact the office nearest you.

Owner: University of Minnesota.

Plans and Specifications by C. H. Johnston, Architects-Engineers, St. Paul, Minnesota.

Fabricated and Erected by American Bridge.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION • GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

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AMERICAN BRIDGE

USS

UNITED STATES STEEL

Door coils above the opening, completely out of the way.

Clears the entire opening — jamb to jamb, floor to lintel.

Opened door stays out of reach of wind or vehicles.

All surrounding floor and wall space is always fully usable.

Rugged all-steel curtain repels wind, fire, theft, vandalism.

Heavily galvanized curtain gives lasting resistance to elements.

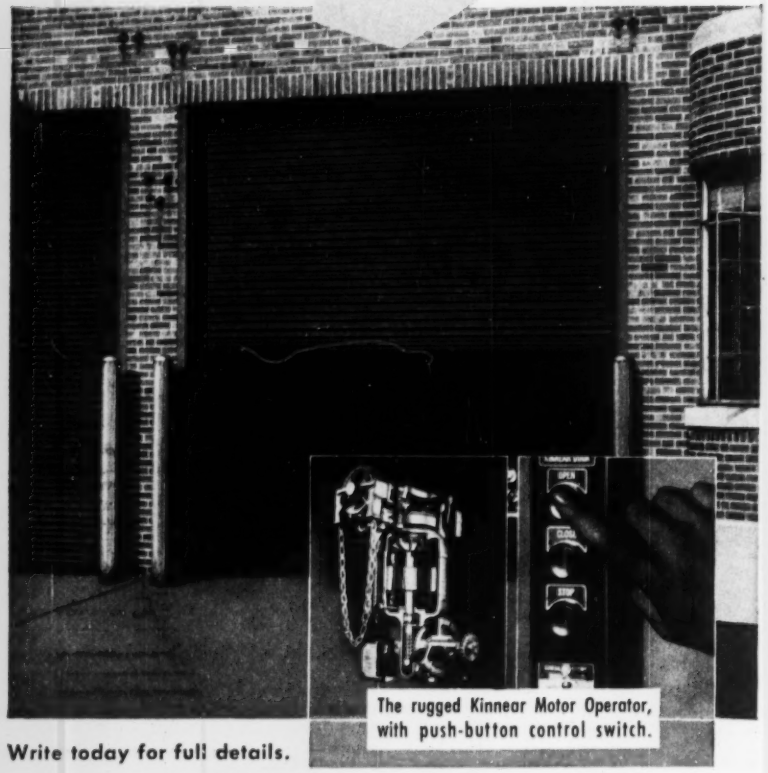
(1.25 ounces of pure zinc per square foot of metal, as per ASTM standards.) Kinnear Paint Bond — a hot phosphate immersion assures thorough, lasting paint grip.

Smooth, easy coiling upward action saves time and labor.

Ideal for motor operation; remote control switches if desired.

Any size; quickly, easily installed in old or new building.

Kinnear Steel Rolling Doors



The rugged Kinnear Motor Operator, with push-button control switch.

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San Francisco 24, Calif.

CATALOG DIGESTS

75 LETTERING MACHINE

Ralph C. Coxhead Corporation—The Vari-Typer engineering lettering machine relieves draftsmen from tedious hand lettering. The machine operates like a typewriter, but has instantly changeable type faces in different styles and sizes to meet the various needs of the tracing or bill of material. The carriage is designed to hold tracings as much as 6 ft or more in width. The type impressions are electrically controlled, producing a uniform, sharp, black character so important to a good tracing. Mathematical symbols as well as draftsmen style lettering are available in the changeable type for cartridge.

76 LIGHT-WEIGHT PIPE AND FITTINGS

Naylor Pipe Company—As a practical help to pipe users, a new bulletin No. 507 is offered, showing typical applications of light-weight lockseam-spiralweld pipe and fittings. Included are standard specifications on pipe from 4" to 30" in diameter, together with data on fabricated fittings, flanges, and connections to meet pipe line requirements.

77 LONG-SPAN STEEL BUILDINGS

Stran-Steel Division, Great Lakes Steel Corp.—Announces an informative new catalog showing Stran-Steel Long-Span Buildings for industry and commerce. Discussed and illustrated are the rigid and bow string frames; roof systems for commercial buildings, building accessories, mailing, insulation and finishing features; details and specifications and typical applications of these buildings.

78 MAGNESIA INSULATION

Johns-Manville—A 12-page illustrated brochure tells how 85% Magnesia is produced, explains why it has high insulating value, points out where it can be used to advantage and goes into detail about special characteristics such as strength, water resistance and appearance. The brochure covers both pipe and block insulation. In tabular form, it gives data on physical and thermal properties.

79 MASONRY CEMENT

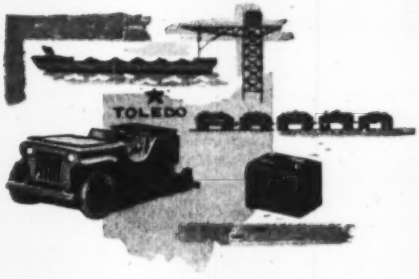
Lone Star Cement Corporation—A 16-page, illustrated booklet outlines the advantages of Lone Star masonry cement in simplifying the problem of obtaining uniformly high-quality mortar, as well as the economy of one rigidly standardized, ready-to-use cementing material instead of two with no lime or portland cement to add, and no soaking or slaking. It provides timely information on soundness, low absorption, high water repellency and other factors contributing to durable, weather-resistant performance. It contains easily-read graphs showing effect of mix proportions on water retention, strength and absorption, effect of mixing time on water retention, etc., along with convenient reference tables for estimating quantities.

80 MEASURING WATER

Thompson Pipe & Steel Company—Self cleaning Thompson Parshall Measuring Flumes give permanently accurate water measurement for streams, ditches and open channels. It is used in water, sewage and industrial plants as well as for irrigation systems. This device is approved by many State Engineers to stop water disputes and waste. Bulletin presents advantages and complete table for free-flow discharge from 0.028 to 72.0 cubic feet per second.

Toledo Prefers

Concrete Pressure Pipe



Toledo engineers prefer concrete pressure pipe for the city's water supply mains. In 1948 an 8,600-foot installation, known as the Bancroft Street Crosstown Main, was completed. Since then 24″, 36″, 48″ and 72″ concrete pressure pipe has been used in major additions to the city's water supply system. Just recently contracts have been signed by Lucas County authorities and work is in progress on additional projects in the Toledo area, involving 16″ and 24″ pipe.

There are a number of reasons for Toledo's increasing use of concrete pressure pipe. Sustained high-carrying capacity and long life are two of the most important. Another is low maintenance cost. The original cost is also low and installation is accomplished quickly and easily.

Talk to Toledo engineers when you plan your next water line. You'll learn why they like concrete pressure pipe—not only for transmission lines, but for city distribution mains as well.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete PRESSURE Pipe

WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
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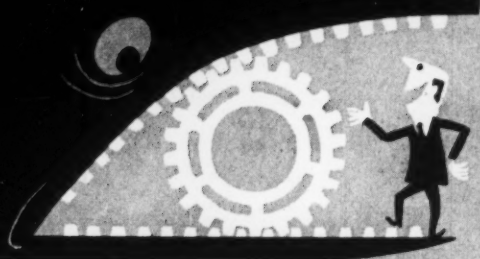

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spiral	⅜″ to 75″	pinions	any size
sykes herringbone	up to 60″	racks	
other herringbone	up to 90″	(straight or curved)	any size

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CATALOG DIGESTS

81 MEASURING WHEELS

The Maintenance Co., Inc.—Attractive, free folder describes how one man using a Mainco Distance Measuring Wheel can do a better, quicker job than two men using chain or tape. Sturdy, accurately built, yet it weighs only 5½ pounds. Mainco Wheels have been serving and saving money for contractors, engineers, utilities, etc., for over 25 years. Repeat orders by same companies is proof of satisfaction. Folder also offers unconditional two weeks free trial.

82 MICROTOMIC DRAWING PENCILS

Eberhard Faber Pencil Company—Announces the publication of their new general catalog, featuring their line of Microtomic drawing pencils, leads & holders, their general line of woodcased pencils, erasers, crayons, Nupastels, penholders, rubber bands and type cleaners.

83 MINE, SHAFT AND INCLINE HOISTS

Superior-Lidgerwood-Mundy Corporation—Bulletin M515 describes and illustrates a full range of steam, electric, gasoline and diesel powered hoisting, machinery, "engineered and designed to suit", yet consisting of standard parts. They are for use in mines, steel works, industrial plants and engineering and contracting projects. Also hoists for special purposes. Sixteen pages include 36 illustrations of important installations; data required for estimating on mine, shaft and incline hoists; general information on mine hoists and hoists for shafts and slopes.

84 MOTOR GRADER

The Galion Iron Works & Mfg. Co.—A free copy of a new 28-page catalog, No. 353, is now available on the Galion Model 104, 93 h.p. motor grader. All important features of design and construction are illustrated and described, and complete specifications are listed. The advantages and construction of Galion features are interestingly presented with detailed cross-section views. Many action photos show the Model 104 heavy-duty grader in all types of maintenance and construction work. Also shown and described are the various attachments which further increase its usefulness.

85 MOTOR GRADER

The Galion Iron Works & Mfg. Co.—Those interested in an extra heavy-duty grader of the 115–125 h.p. class will be interested in Galion's new free catalog, No. 395 on their model 118 all-gear, tandem drive motor grader. Operating and construction features are profusely illustrated and completely described. Extra equipment such as hydraulic shiftable moldboard and creeper transmission are also described in detail.

86 MOTOR SCRAPERS

Allis-Chalmers Manufacturing Company—The TS-200 motor scrapers and TR-200 motor wagon, rubber tired earthmoving units, are described in the two-color catalog in which components of the two units are also featured. Numerous action photos are used to tell a graphic story of job application by the two units. The motor scraper has a 10-cu. yd. struck and 13-cu. yd. heaped capacity; the motor wagon 11-cu. yds. struck and 15-cu. yds. heaped, or 18 tons capacity.

87 MOTOR SWEEPER

Austin-Western Co.—A 16-page catalog AD-2170, pictures and describes the Model 40 motor sweeper with its unique direct broom-to-hopper sweeping which makes unnecessary the conventional belt conveyor or squeegee elevator. While designed primarily for use by municipal street and park departments, the Model 40 is also well adapted to use on airports, and in and about industrial plants of many types. Included in the catalog are brief specifications and photographs of the sweeper in operation on typical jobs.

Powered by a two-drum hoist mounted on a tractor stationed on a highway rise, this Sauerman Crescent Scraper is doing a "first-rate" job of cleaning a drainage channel.

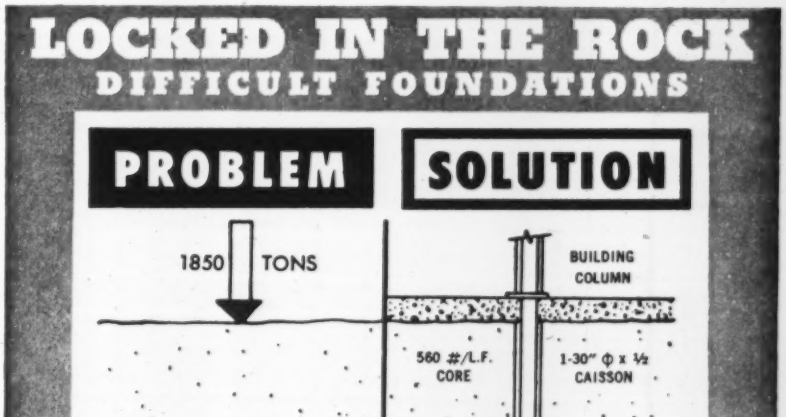
For similar operations, such as cleaning under culverts, removing silt from storm sewers or working in places where head room is too limited for other machines, the Crescent-tractor combination gives you the same versatile efficiency at low investment cost.

The Crescent, working between an anchorage and the hoist, will deposit excavated material anywhere along the span simply by reversing the forward pull. Through an opening no larger than its own width, the Crescent can be started through an underpass. It digs equally well on firm ground, boggy material or under water.

Write for Field Report 209 describing the use of Crescent Scrapers with tractors. This illustrated report tells how to use a scraper with your tractor and gives you cost figures on representative jobs. For similar information on the use of Crescent Scrapers with boom machines, request Field Report 219 and Catalog J.

SAUERMAN BROS., INC.
552 S. Clinton St., Chicago 7, Ill.

SAUERMAN BROS., Inc.



CATALOG DIGESTS

88 MORTAR CEMENT

Universal Atlas Cement Company—The booklet "Good Masonry Deserves Atlas Mortar Cement" is now available. Masonry is no better than its mortar is the opening point made in this booklet. It also outlines the advantages of using prepared mortar cement and backs this up with comments from men who use it. It further points out that behind Atlas Mortar Cement are years of laboratory and field research. This quality product complies fully with ASTM and Federal Specifications for masonry cement and provides in a single material a mortar cement that rates high in all desirable characteristics—plasticity, yield, volume change, water-retention, durability, strength and color.

89 NEW LEFAX TECHNICAL DATA BOOKS

Lefax—Presents a newly revised technical data books for engineers, technical men, surveyors and students. Each book contains about 140 looseleaf pages of up-to-date material arranged for ready reference. Partial listing includes: Architecture, Building Construction and Design Aids, Reinforced Concrete, Steel Forms and Shapes, Surveying Theory and Practice, Surveying Tables, Highway Engineering, General Math, Trig-Log Tables. Manuals sell for $1.25 each, or 6 for $5.00. FREE 1955 Catalog with over 2000 listings is available on request.

90 PACKAGE WATER CONDITIONER

The Permutit Company—An 8 page bulletin, 3869 describes Permutit's Package Water Conditioning Plant, an extremely versatile, self-contained unit, designed to coagulate, clarify, filter, neutralize, de-alkalize, and soften raw water supplies. Listed are the component parts, principles of operation, ratings, capacities, and sizes. This bulletin should be of interest to all engineers dealing with water problems.

91 PAVING TREATMENTS

American Bitumuls & Asphalt Company—A 28-page, two-color booklet describes in fully scenic photographic form and with basic tabular data the newest practice in step-by-step construction of surface treatments, armorcoats and penetration pavements with Bitumuls emulsified asphalt.

92 PENCIL SAMPLE KIT

American Pencil Company—FREE! New Venus Blueprint Pencil Sample Kit. See for yourself how new Venus Blueprint Pencils give you more brilliant, clear, non-smear markings on all blue or white prints and coarse papers. Specially formulated lead is the reason. Sharpens to a needle point, never powders or smudges; markings are opaque and insoluble, resist oil and grease. Electronically controlled color accuracy. Kit includes two new Venus Blueprint Pencils plus a Venus Drawing Pencil.

93 PLANT DESCRIBED

Flint Steel Corporation—Offers three, 12-page, two-color brochures describing the overall sales, engineering, detailing, estimating and fabrication facilities of the Tulsa and Memphis Plant. The three specialized divisions of the company are described separately, one in each book. They are galvanized towers and substations, structural and reinforcing, and plate and tank divisions.

94 PILES

Raymond Concrete Pile Company—Standard and step-tapered piles are described in Catalog S-54 which also includes information on the scope of Raymond's activities covering every recognized type of pile foundation-cast-in-place, precast and prestressed concrete, composite, steel, pipe and wood piles; also caissons, underpinning. Domestic operations include harbor and waterfront construction, and cement-mortar lining of pipelines in place. Raymond's services abroad also include all types of general construction.

95 PILES

The Union Metal Mfg. Co.—Test load data, engineering tables and descriptive information are contained in Catalog No. 81 on Monotube piles. It also includes numerous photos showing a wide range of job applications throughout the country. The Monotube is a fluted, tubular steel pile, either fully tapered or combining tapered and uniform sections. It is driven directly with a standard crane, leads and hammer, without the use of driving core or mandrel. Advantages listed: light weight, easy handling, speedy driving, economical field extensibility, visual inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

96 PIPE LININGS

Centriline Corp.—Booklet describes cleaning and cement lining of metal pipes in place underground in sizes from 4 to 144 in. These linings increase and maintain pipe-carrying capacity, protect pipe against corrosion, and prevent leakage where pipe has been penetrated by exterior or interior corrosion.

97 BARCO PORTABLE GASOLINE RAMMER

Barco Manufacturing Company—Offers an eight-page catalog describing the Barco Portable Gasoline Rammer for soil compaction. This tool is the only successful mechanical means of obtaining specified soil compaction in restricted areas such as in trenches and near walls and bridge abutments. It is easy to operate, safe, and will compact 20 to 30 cubic yards of fill per hour where high degree compaction is specified. Barco also offers a bulletin "Cost Data for Soil Compaction in Restricted Areas with the Barco Rammer" of interest to all earth moving contractors.

98 PORTABLE POWERED RIGS

Acker Drill Co., Inc.—Acker Bulletin 28 describes both Acker Light duty RGT and Heavy duty RG portable powered soil sampling rigs. Acker SK drill heads are also described. This unit can be added to either the RGT or RG units for rock coring.

99 POWER GRADERS

Austin-Western Co.—A 24-page catalog, AD-2112-R1, pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

100 PRECAST CONCRETE WALL PANELS

Portland Cement Association—A 16-page illustrated booklet discusses various types of precast concrete panels and shows their use in buildings where walls are attached to the structural frame. Line drawings illustrate details for different panel types including solid sections, sandwich, thin-wall and others. Sandwich panels have insulation between two layers of concrete. Inserts, joints and methods of attachment are also shown.

101 PRECIPITATOR

The Permutit Company—A 20-page Bulletin, 2204B, covers applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of Permutit's Precipitator. Three basic designs offer efficient means of removing impurities from a liquid by precipitation, absorption, settling, and filtration. It requires less space, less chemicals and less reaction time than previous designs. Softens water, removes turbidity, color, taste, odor, reduces alkalinity, silica, and fluorides.

102 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—Complete specifications on the Berger "N" line of moderate-priced builders' instruments are included in an illustrated brochure now available. Companion line to the company's engineering, mining and astronomical instruments, the "N" line consists of a convertible transit-level, a 12-in. heavy-duty dumpy level, a service transit level (farm level) and a hand level.

103 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—"Solar Ephemeris and Polaris Tables," 1954 Edition, 96 pages, contains complete instructions for determining azimuths from the sun and the altitude of Polaris, prepared by Herman J. Shea, associate professor of surveying, Massachusetts Institute of Technology. Directions for making astronomical observations and computing results by direct solar observation and time from same observation: meridian by solar attachment; meridian by Polaris at elongation; azimuth by Polaris at any hour angle; latitude by sun at noon, and latitude by Polaris are included, as well as all requisite tables. Price is $.50 per copy.

N. B. *There is a charge for this book. Make checks payable to C. L. Berger & Sons, Inc.*

104 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—An informative, 4-page brochure, combining a catalog and calculating chart, has been prepared. Pictured in four colors on the cover is the Berger Type R transit, one of the many instruments produced by the 82-year-old firm. On the center spread are photographs and code names for 12 types of Berger instruments, from an 18-in. dumpy level to a plane table alidade.

105 PRECISION TRANSIT

Warren-Knight Co.—The new circular, CE7, describing the latest Model medium size Precision Transit No. 7-CF is available. This new Model Transit has a number of exclusive features that make it the outstanding instrument of its kind today. The Transit has a new 24 power internal focusing telescope with disappearing stadia, axle end focusing, replaceable leveling screws in bushings, etc., and weighs less than 13 lbs without using any light alloys in its construction.

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Mayo Steel Tunnel Forms have been used on major Tunnel Jobs in every part of the world. The requirements of these jobs necessitated our producing all types of Forms—telescopic, non-telescopic, separate sidewall and arch, single unit, full round forms for monolithic pours, etc. Each Mayo Steel Form is designed for the exact requirements of the job—be it Tunnel, Sewer or Conduit!

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Headframes
Muck Bins
Shields • Air Locks
Locomotives
Mine Cars
Grouters

CATALOG DIGESTS

106 PRESSURE FILTERS

The Permutit Company—A 16-page bulletin No. 2225-B describes the complete line of pressure filters horizontal and vertical, with multiple valves, manually operated multiport valves and automatic multiport valve control. Specifications, operating characteristics, outline dimensions and typical installation of these filters and associated accessories have been included.

107 PUMPS

Johnston Pump Company—Offers an eight-page two-color bulletin describing its Unit-Line Sump Pumps. It is profusely illustrated with dimensional charts, graphs and other informative data.

108 RACK RAKE

Newport News Shipbuilding and Dry Dock Co.—A 32-page, two-color booklet has information regarding the Newport News Mechanical Rack Rake used to clean trash racks at water intakes for hydroelectric plants, steam plants, pumping stations, canals, and similar installations. Booklet includes a number of typical installation arrangements for a variety of developments.

109 RASCHIG RINGS

Johns-Manville—"J-M Raschig Rings" is the title of a four-page folder just issued. These spit metal Raschig Rings are made from any required metal in diameters from 1/4 in. to 3 in. They are available in almost any size or thickness of metal in many different ratios of diameter to length for packed towers in absorption, fractionation, extraction and other related processes. This new folder provides data for engineering firms who are designing and constructing new towers and for engineers who specify packing for existing towers.

110 REDUCED HEAT EVOLUTION IN CONCRETE

The Master Builders Co.—A 4-page illustrated folder describes use of Low Heat Pozzolith for reducing total heat evolution in mass concrete, in structural concrete and flat slabs—in hot weather and in tropic and semi-tropic areas. Compares Low Heat Pozzilith mixes with plain and air-entrained concrete mixes in regard to bleeding, bond to steel, volume change, impermeability, resistance to freezing and thawing, heat evolution and flat slab finishing.

111 REINFORCED BRICK MASONRY

Structural Clay Products Institute—The first complete, authoritative handbook on the use of reinforced brick masonry in construction, entitled "Reinforced Brick Masonry and Lateral Force Design," fills a recognized need for technical information on lateral force design in masonry for architects and engineers. The principles of R B M design are the same as those nationally accepted for reinforced concrete but offer lower cost and more flexibility. The book reviews accepted design criteria, suggests methods of calculating stresses, and recommends reinforced brick masonry building code requirements. The price is $4.95.

N. B. There is a charge for this book. Make checks payable to Structural Clay Products Institute.

112 REINFORCED CONCRETE PRESSURE PIPE

Universal Concrete Pipe Company—Invites requests for their new 16-page brochure prepared by the nationally-known consulting engineer, M. W. Loving. The picture packed booklet shows and describes in detail the use of Universal's reinforced concrete pressure pipe in the new Miami, Florida sewage disposal system.

113 RING-TITE COUPLINGS

Johns-Manville—A 6-page illustrated folder shows how the Ring-Tite Coupling goes together, points out installation time savings, explains economies in service and cites typical uses in various parts of the United States. Data on sizes and weights is included, and the folder gives basic information on the Transite asbestos cement pipe with which the coupling is used.

114 ROLL-O-MATIC TANDEM ROLLERS

The Galion Iron Works & Mfg. Co.—An interesting new catalog on an advanced type of tandem roller drive called "Roll-O-Matic" is available. Construction features of Galion tandem rollers are fully illustrated in the catalog, and complete specifications are listed. Write the manufacturer or any of their distributors for a free copy of Catalog No. 400.

115 ROLL-ON JOINT PIPE

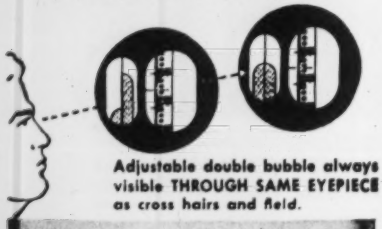
The American Cast Iron Pipe Company—Manufactures Mono-Cast centrifugal pipe in diameters 2" to 48" inclusive. Among the joints offered with this pipe is the Roll-On Joint now available in both large and small diameter pipe. A brochure describing this product will be sent on request.

116 ROLLS

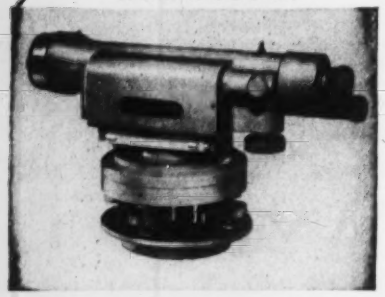
Rodney Hunt Machine Co.—Has released a revised edition of a complete catalog on metal, rubber, wood and plastic rolls. The catalog consists of 48 pages with an appendix of tear-out dimension sheets for use in supplying specifications on rolls, fulling-mill lags and textile machinery reels. Also includes a page on the simple but valuable routine by which wood or rubber rolls, properly cared for, can be made to deliver a greatly extended service life.

SURVEYING NEWS

NEW LEVEL WITH DOUBLE BUBBLE IS "MISTAKE-FREE"



Adjustable double bubble always visible THROUGH SAME EYEPIECE as cross hairs and field.



- No need to turn telescope during leveling
- No need to look anywhere but through telescope to adjust level at any turn after initial set-up
- American type — erecting eyepiece, 4 leveling screws
- Unbelievably fast and accurate, yet simple-to-use. Economical!

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INSTRUMENT CORP. OF AMERICA
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Please send me Booklet C with information on Fennel . . .

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☐ Combinations ☐ Tripods
☐ Theodolites ☐ Repair of my present instruments

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CATALOG DIGESTS

117 ROTARY CAR DUMPERS

Link-Belt Co.—Rotary car dumpers for railroad gondola cars and for mine cars are described in Book 2048A. These automatic machines can rotate a car, empty its load and right it in 60 to 90 seconds. Line drawings and photographs show the many applications of these machines.

118 SCREW CONVEYORS AND FEEDERS

Link-Belt Company—Screw conveyors and screw feeders, simple and versatile handling mediums for hundreds of materials, are covered in Book No. 2289. Over 250 of these materials are listed and classified by size, flowability, abrasiveness, average weight and other characteristics. The book also gives detailed engineering information, with selection tables and horsepower formulas, layouts and arrangements, dimensional data and part numbers, to permit selection of screw conveyors and screw feeders for many applications.

119 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems, either by cutting off such flows entirely during storm periods, or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

120 SEWER PIPE CLEANING TOOLS

Flexible Sales Corporation—If you are directly connected with pipe cleaning or have a sewage problem, fully illustrated and detailed information will gladly be mailed relative to their line of sewer pipe cleaning tools.

121 SHOVEL CRANES

Link-Belt Speeder Corp.—Has released a new catalog fully describing the Link-Belt Speeder LS-98 Shovel Crane. Among the features discussed are Speed-O-Matic hydraulic control and its advantages, the upper machinery, the front end attachments available, and the choice of crawler mountings or shoe widths suitable to the job. The HC-98 truck-crane carrier and the MS-98 self-propelled carrier are also shown and discussed. For other catalogs covering individual models of the complete line of shovel-cranes write direct to Link-Belt Speeder Corp., 307 N. Michigan Ave., Chicago, Ill.

122 STEEL

Ingalls Iron Works—Offers a 27-page brochure called "Tailoring With Steel." Included in this attractive, multi-color brochure are glossy on-the-job photographs, complete data on the fabrication of steel, and other application information.

123 STEEL FORMS

Economy Forms Corp.—A booklet on steel forms for concrete construction is offered. It has numerous pictures showing the simple handling, applications, and use of the forms for all types of heavy construction; tunnels, culverts, sewage & water treatment plants. Special forms designed to solve concrete construction problems are also shown.

124 STEEL STORAGE BINS

Heltzel Steel Form & Iron Co.—Offers Bulletin No. 0-35, describing Heltzel circular, square and special purpose Steel Storage Bins. Diagrams and specifications are given as well as actual photographs. A sampling of the many types of gates and discharge arrangements is also pictured.

Fines Separation and Control with HARDINGE HYDRO-CLASSIFIERS

The Hardinge Hydro-Classifier is a large-volume classifier for fine separating problems. It makes an efficient and economical unit, with positive control of the sizing and moisture of both oversize and fines. Separations from 48 mesh to finer than 400 mesh are possible. The coarse materials discharge at the bottom; the fines overflow the weir. May be supplied with screw dewaterer to discharge the underflow in a semi-dry condition. State your classification problem. Bulletin 39-B-37.

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CATALOG DIGESTS

125 STEEL TUBING

Pacific Tube Co.—A 6-page folder describes the company facilities and its wide range of quality tubing: cold drawn, welded, welded and drawn, and welded not finished as well as cold finished rods and bars. It outlines tolerances and average physical properties, together with useful information for determining size and strengths.

126 STRESS-GRADE LUMBER

Timber Engineering Company—Has available the technical publication, "National Design Specification for Stress-Grade Lumber and Its Fastenings." It is based on and recognizes the value of competent engineering design, accurate fabrication and adequate supervision of construction where stress-grade lumber is used.

127 STRUCTURAL ARC WELDING

The Lincoln Electric Company—A series of case histories in structural arc welding is issued periodically. Current series studies: the design of a continuous girder bridge without floor beams; a seven span bridge, 762 feet long and 86 feet wide; roadway supported on each side by five lines of girders on which rests the reinforced concrete slab. The study presents detailed drawings and explanatory notes.

128 STRUCTURAL FLOORS

H. H. Robertson Company—Defers a design + cost factors booklet to help you readily compute the cost of all types of structural floors with integral electrical wiring systems and compare them with Q-Floor. The study is based upon a typical multi-story building and is replete with charts and cost studies of all components to enable you to accurately estimate for your own vicinity. A critical analysis of this nature should be included in every architectural and engineering library.

There are 159 Digest items on pages 100 to 126. Read all items for the literature of interest to you.

129 STRUCTURAL SHAPES

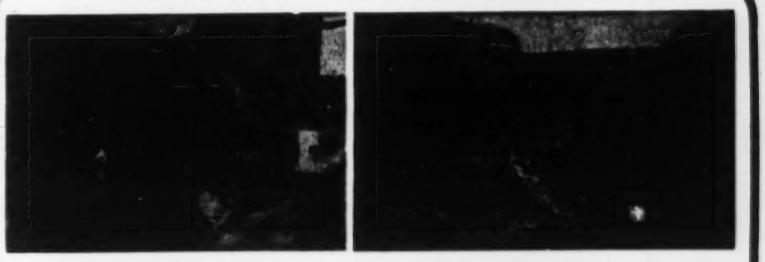
Unites States Steel Corporation—A 72-page hard-bound book, ADV-17831, containing complete properties and dimension tables of various structural shapes, including diagram drawings of each. Also included are plate size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails and corrugated sheets.

130 SUMPMASTER PUMP

Byron Jackson—Has a two-color 19-page bulletin describing BJ Sumpmaster Pumps. Bulletin No. 31420, provides the ready-made answer to your pumping application and problems by conveniently presenting: easy to use selection tables; complete outline and dimension drawings. Contractors, engineers, architects, and designers will find this bulletin of great value in their work.

131 SURVEYING ALTIMETERS

American Paulin System—Micro and Terra Altimeters, and the Micro Surveying Barograph are illustrated, and their specifications given in this new brochure. The necessary accessories are listed as well.



DAM SAVED WITH "GUNITE" BY CEMENT GUN COMPANY

Recently we were called upon to make "GUNITE" repairs on the Connecticut Light and Power Corporation's Tunnel Dam. Its poor condition, at that time, is shown in the upper right picture.

After chipping away all loose and unsound masonry, we installed a system of drainage channels and weep pipes and completely reintegrated the down-stream face with reinforced "GUNITE." The photo at left shows the actual application of "GUNITE" over welded reinforcing mesh.

Other dams we have saved by this method are pictured in Bulletin B2400 together with a wide variety of other "GUNITE" applications. Write today, on your letterhead, for a copy.

CEMENT GUN COMPANY
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GENERAL OFFICES – ALLENTOWN, PA., U. S. A.
MANUFACTURERS OF THE CEMENT GUN

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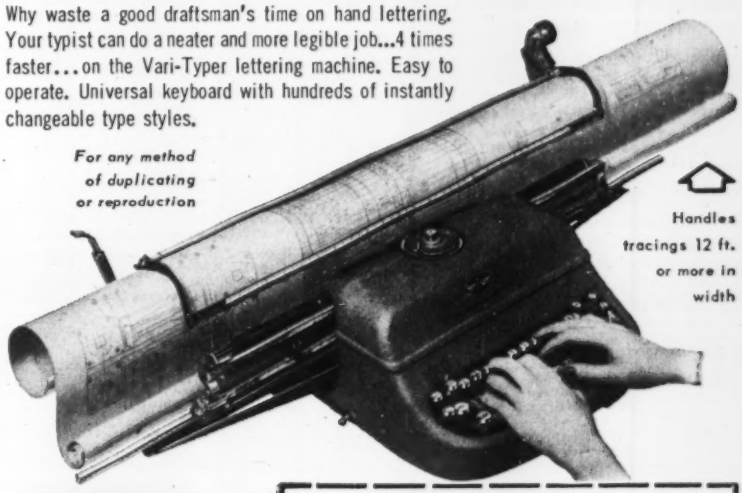

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- SLAB BOLSTER. #4 top wire, precision corrugated 1" on center, to assist the steel setter in placing bars. #7 wire legs, 5" on center for ¾ height. Over ¾", #5 legs. Stocked in 5'– 0" lengths.

For additional information on our full line of building and concrete specialties, write for the free current, detailed CONVER Catalog. Just fill in and mail coupon below.

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Please send complete information on CONVER Building Aids.

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CATALOG DIGESTS

132 SURVEYING INSTRUMENTS

C. L. Berger & Sons, Inc.—A 16-page condensed catalog, "Accuracy in Action," illustrates the engineering and surveying instruments manufactured by the company. General characteristics, optical systems and accessories for the Berger line of engineers' transits, levels, mining transits, theodolites, collimators and alidades are fully described with essential specifications for each. A section devoted to builders' and contractors' instruments is also included.

133 SURVEYING INSTRUMENTS

Fennel Instrument Corporation of America—Offers a folder on their line of precision instruments. Photographs, detailed descriptions of the models, prices, etc., are included.

134 SURVEYING INSTRUMENTS

Kern Instruments, Inc.—A 32-page brochure offers a brief description of the most important instruments manufactured by world-famed Kern & Co., Ltd., of Aarau, Switzerland. Fully illustrated, it acts as an index to the detailed literature available on each instrument. Included in the brochure are theodolities, levels, self-reducing tacheometers, alidades, pentagonal prisms and many other exceptionally fine instruments. Also, a brochure on the optical plummet used at Hungry Horse Dam.

135 SWIMMING POOL EQUIPMENT

National Pool Equipment Co.—Has for free distribution a 20-page catalog fully illustrating the most complete line of highest quality pool supplies and equipment—full of drawings and charts for the prospective pool owner, architect or engineer.

136 THEODOLITE

Geo-Optic Company, Inc.—Has a leaflet describing the optical universal theodolite Askania TKT Transit with terrestric telescope (erecting eyepiece). The Askania TKT Transit enables surveyors to cope with any possible problem of triangulation and to obtain results of the highest accuracy. All readings are done from one position—an important time factor. Other advantages and data are included.

137 TIDE GATES

Brown & Brown, Inc.—Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

138 TIMBER CONNECTOR CONSTRUCTION

Timber Engineering Company—Is offering the publication "Teco Design Manual for Teco Timber Connector Construction," describing various connectors and factors affecting design data, and providing design and load data for the various timber connectors.

139 TUNNEL LINERS

Commercial Shearing & Stamping Company—Has just published a free 28-page catalog concerning tunnel linings. Described are steel liner plates for water tunnels, sewer tunnels, railroad tunnels, service tunnels, highway tunnels, caissons, shafts, mine roofs and overcasts. On-the-spot photographs and informative tables help to tell the complete tunnel lining story.

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Light-weight, compact and dependable instrument particularly suited for forestry and general engineering.

The WILD T-O can be used both as a standard transit and as a compass instrument.

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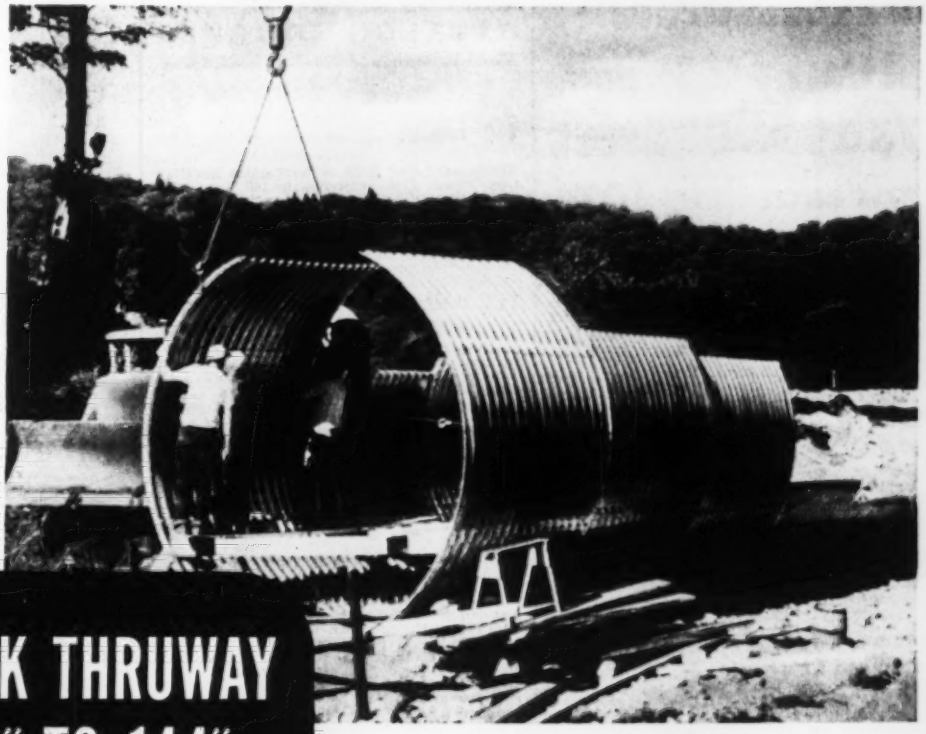


Workmen bolting together 144" diameter Armco MULTI-PLATE Pipe for New York Thruway.

NEW YORK THRUWAY USES 6" TO 144" ARMCO PIPE UNDER PAVEMENT

By actual count, 27 different sizes of Armco Corrugated Metal Drainage Structures were installed under the pavement of the New York Thruway. These included various sizes of Armco Corrugated Metal Pipe, Pipe-Arch, MULTI-PLATE Pipe, and MULTI-PLATE Pipe-Arch.

All of these metal structures are designed for fast, easy, labor-saving installation. It is a simple matter to join 20-foot sections of standard corrugated metal pipe with bolted coupling bands. MULTI-PLATE structures are assembled by bolting curved and corrugated plates together. Tamping and backfilling completes the job for either structure.

Assembled 60" diameter Armco MULTI-PLATE Pipe ready for backfilling

More and more of today's modern turnpikes and expressways are using Armco Metal Drainage Structures. They are strong, durable and can be installed under almost any fill height. For complete information write Armco Drainage & Metal Products, Inc., 3554 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO DRAINAGE STRUCTURES

ARMCO

WELDED DESIGN ELIMINATES 73 TONS OF STEEL

...cuts costs 10%

THE welded design for the New York International Airport Hangar was bid at $449,018.00. A riveted design was quoted at $451,110.00.

Although the structure was originally planned for riveting, the welding alternate used 5% less steel . . . saved $2,092.00 on construction costs.

The welded steel hangar cantilever trusses extend 134 feet on either side of the center frame. The trusses were shop fabricated and shipped in half sections, field assembled by arc welding.

Savings like these can be realized on many types of structures when designed for welding.

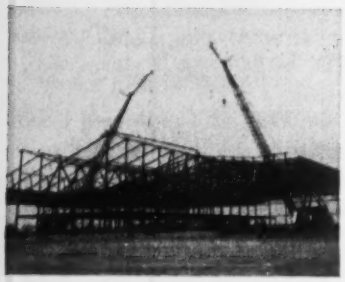


Fig. 1. *347-ton welded framework at Idlewild Airport. Designed to house 5 large and 3 small transports. Designed by Port of New York Authority. Fabricators and Erectors, Lehigh Structural Steel Company.*

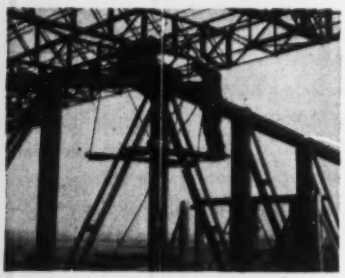


Fig. 2. *Erecting shop-fabricated half-sections to form 134' trusses by arc welding.*

SEND FOR additional data on welded design by writing for "Lincoln Studies in Structural Arc Welding".

THE LINCOLN ELECTRIC COMPANY
Dept. 2405, Cleveland 17, Ohio
THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

CATALOG DIGESTS

140 TURBINES

The James Leffel & Co.—The Turbine Installation Folder #1085 describes in full detail the installations of Leffel Turbines at the Anderson Ranch Dam in Idaho. Materials pertaining to other Leffel projects will be included.

141 UNDERGROUND AIR-OPERATED CORE DRILLS

Sprague & Henwood, Inc.—A 4-page 2-color bulletin, No. 340, recently issued, illustrates and describes two sizes of air-operated machines for either core drilling or blast-hole drilling underground and gives complete working data. Rod-pulling apparatus, with air-actuated piston, is described for each machine. This bulletin also summarizes their wide line of diamond bits and other accessory equipment for all diamond drilling requirements.

142 UPWARD-ACTING DOORS

The Kinnear Manufacturing Co.—The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features, and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 79, it gives information on installation clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

143 VALVES

Martin Iron Works, Ltd.—Presents an informative pamphlet on their line of low cost valves and gate valves. Described are type X flap valve, hub end gate valve, and types L, W, XL, and LC gate valves. If you have a flow control problem, a Martin Gate Valve may supply the answer.

144 VERTICAL PUMPS

Johnston Pump Company—Announces an attractive new three-color pamphlet dealing with the Vertical Turbine type Volatile Fluids Pumps. Discussed, are the design advantages, and mechanical features of these pumps. Included, are diagrams and photographs stressing unlimited flexibility of installation, individuality in job requirements and economy.

145 WALL-FORM CONSTRUCTION

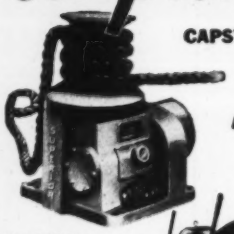
Symons Clamp & Mfg. Co.—Offers a new catalog, F-10, on its system of wall-form construction. Latest information and improvement in the Symons Forming System are given. Illustrations show in detail: how simply and easily the forming system operates; actual construction where forms have been used; the forms are shown in use as in completed jobs, also contains detailed information on Safety Shores and Column Clamps. Symons Engineering Department prepares, free-of-charge, form layouts, bills of material and cost sheets for new jobs you are figuring.

146 WATER CONTROL APPARATUS

Rodney Hunt Machine Co.—A 250-page comprehensive catalog, WCA 952, shows the full scope of Rodney Hunt Water Control Apparatus. It consists of eight sections; sluice gates, timber gates, hoists, fabricated gates, racks and rakes, valves, engineering data. Included are hundreds of diagrams, photographs with detailed descriptions, and specifications. Offered only to consulting engineers, contractors and others actively engaged in water control construction work. Requests must be made on business or official letterheads, stating title and position.

"Superior" Electric

Carpullers



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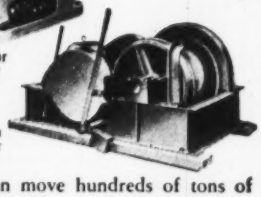

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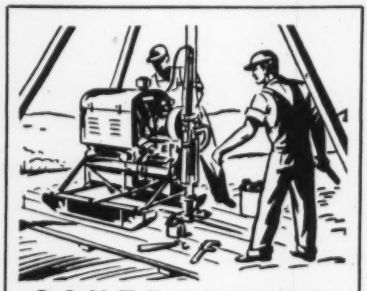

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More than sixty years of successful experience backed by superior equipment and ample financial resources, constitute your best possible assurance of satisfactory service. Manufacturers, also of Diamond Core Drilling Machines and complete accessory equipment, including all types of Diamond Drilling Bits.

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Servicised White Pigmented Curing Compound is widely used in areas where atmospheric temperatures exceed 80° F. because it produces a membrane capable of reflecting heat to reduce concrete temperatures as much as 15° F. Even application, using minimum material and application time. May be sprayed or brushed.

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TIDE GATES

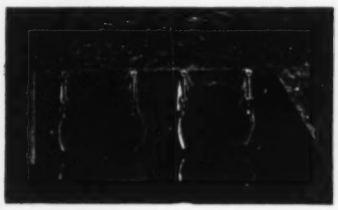


Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

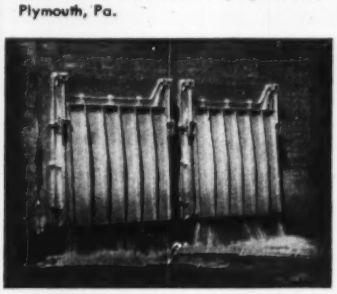


Fig. B-124-C
Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

BROWN & BROWN, INC.
LIMA, OHIO, U.S.A.

CATALOG DIGESTS

147 WATER DAMAGE CONTROL

Western Waterproofing Co., Inc.—This is a practical, professional treatise on water damage control, written by an expert in the field, especially for church property administrators. In 6 pages of pictures and text the author discusses three basic types of treatment—preventive, remedial and restoration—and how and when they should be applied to the five common classes of construction usually found in church buildings—old brick, new brick, stone, concrete and pre-cast block.

148 WATER FILTERS

% Proportioneers, Inc. %—Bulletin 1800 describes Pur-O-Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swimming pool recirculation systems. Engineering data on the application of these filters, including specifications and dimensions covering the complete recirculation and purification systems are given.

149 WATER MAIN CLEANING TOOLS

Flexible Sales Corporation—If you are directly connected with water works maintenance, fully illustrated and detailed information will gladly be mailed relative to their line of water pipe cleaning.

150 WATER POWER EQUIPMENT

Newport News Shipbuilding and Dry Dock Co.—A 75-page, two-color booklet pictures 40 hydraulic power developments and some of the equipment furnished by the company. Details of the developments and other engineering information regarding their building and operation is included.

151 WATERPROOFING SERVICES

Western Waterproofing Co., Inc.—A folder explains the "when, why and how" for specifying waterproofing services to protect new and old structures from above-grade water penetration, interior wall dampness and subsurface water seepage. It deals specifically with such problems as wet walls, shrinkage in brickwork and foundation water seepage and describes the scope and method of protection or restoration work that would be specified for each. Includes building cleaning methods.

152 WATER, SEWAGE AND TRADE WASTE EQUIPMENT

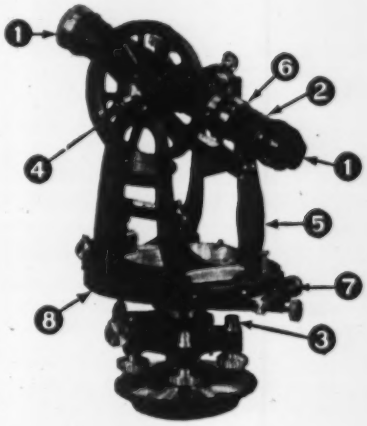
Hardinge Company, Inc.—Has released a 6-page, color brochure describing its line of water, sewage and trade waste treating equipment—Bulletin AH-442. Numerous installations of Hardinge Circular Clarifiers are illustrated and the various applications of this equipment are discussed. Also included are several typical flow sheets and a brief description of auxiliary apparatus such as digestors and flocculating equipment.

153 WATER WELLS, PUMPS, SERVICES

Layne & Bowler, Inc.—Gives brief descriptions of its comprehensive water supply equipment and services for municipalities, industries and farms in new illustrated folders. Subjects include water well drilling, special drilling, vertical turbine pumps, irrigation pumps, specially designed pumps, shutter screens for gravel wall wells, water well acidizing and other service work. The folders describe additional helpful literature available on each of these subjects.

Ask the man behind the "gun"...

How these 8 major design advances make White the top engineers' transit



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TOMORROW as in the past, White Engineers' Transits will continue to offer the most up-to-date design and construction features. This results in greater accuracy, longer instrument life, easier use. To get all the details write for Bulletin 1053. DAVID WHITE CO., 359 W. Court St., Milwaukee 12, Wis.

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Because of the many inquiries received from members for Life Insurance to protect their wives and children, we have arranged with insurance companies specializing in foreign coverage for quick and dependable service at minimum rates.

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154 WELLPOINT DEWATERING

Griffin Wellpoint Corporation—"The Wellpoint System in Principle and Practice" is a handbook on the fundamentals of wellpoint dewatering and is applicable to any wellpoint system regardless of manufacture. This handbook is now available and contains information on how a wellpoint system functions, and methods of planning, layout, installation and removal of the system. The manual is pocket-size, 109 pp. in length, and contains 62 diagrams and illustrations.

N. B.—Contractors and engineers can obtain this book free by sending requests on their letterheads. Others must pay charge of $1.50 by sending check payable to Griffin Wellpoint Corporation.

155 WELLPOINT SYSTEM

Moretrench Corporation—A new, informative, 76-page catalogue, fully illustrated, describes the Moretrench Wellpoint System and its use in dewatering various types of construction projects. Includes useful technical data on the system.

156 WELLPOINT UNWATERING SYSTEM

John W. Stang Corporation—A new 100-page revised edition of our catalog describes the component parts of the Stang wellpoint unwatering system; its planning, engineering and various methods of installation. Numerous recent projects have been added to demonstrate either a new application or some novel technical feature in the engineering and installation of the wellpoint equipment. Specific installations on dams, powerhouses, pipelines, tunnels, etc., are illustrated from photographs made in the field. Heavy construction of all types in all varieties of soil conditions where ground water is encountered is described fully.

157 WILD POCKET THEODOLITE

Wild Heerbrugg Instruments Inc.—A well illustrated booklet describes the new Wild T-12 pocket theodolite. Due to a new optical design of the telescope the instrument is unusually compact and its total weight, including metal carrying container and tripod is 7 pounds. The T-12 is specially suited for preliminary surveys, reconnaissance work, construction and location surveys. The price complete with tripod is $245.00.

158 WIRE ROPE

Jones & Laughlin Steel Corporation—Just issued is an attractive three-color, 96-page handbook called "Wire Rope is a Machine." It contains illustrative cartoons, charts and diagrams. The handbook should prove helpful to engineers and contractors in the construction field because it is planned to help get the most possible service out of wire rope.

159 WIRE ROPE RECOMMENDATION BOOK

American Steel & Wire Co.—Offers a new 40-page brochure called "The Right Rope for the Job." This brochure gives recommendations for efficient and economical types of wire rope to be used in the various fields of service. For convenience and ready reference these recommendations are indexed under the major fields of service. Equipment utilizing wire rope is listed under the major headings, with specific recommendations for applications on that type of equipment.

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PROCEEDINGS AVAILABLE

The following papers have become available as Proceedings-Separates. Following the date of issue of a paper, discussions thereof will be received for a period of three months, as specified on the cover of the paper. Titles will be added to this list every month, as they become available. Technical Division sponsorship is indicated by an abbreviation at the end of each item, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. Papers issued prior to, and including, Separate No. 289, were not distributed under the present automatic mailing system. If you have not registered in a Technical Division to receive its papers (one Division only) free of charge, please do so promptly by filling out and mailing the enrollment and subscription form (page 129) to Society Headquarters. For ordering separate papers, use the convenient order form on page 128.

Listed in Earlier Issues

476. Studies of Bearpaw Shale at a Damsite in Saskatchewan, by Robert Peterson. (SM)

477. Some Applications of Geology in Soil Mechanics and Foundation Engineering, by Parker D. Trask and H. B. Seed. (SM)

478. Discussion of PROCEEDINGS-SEPARATES 192, 315, 324, 326. (SM)

479. Discussion of PROCEEDINGS-SEPARATES 188, 254, 297. (HY)

480. Discussion of PROCEEDINGS-SEPARATES 182, 198, 201, 245, 291. (ST)

481. Discussion of PROCEEDINGS-SEPARATES 208, 231, 302, 307, 336, 392, 399. (SA)

482. Equation of the Free-Falling Nappe, by Fred W. Blaisdell.

483. Flood Insurance, by H. Alden Foster. (HY)

September

484. Slip of Joints Under Static Loads, by R. A. Hechtman, D. R. Young, A. G. Chin, and E. R. Savikko. (ST) The paper reports the results of seventy-two tests to determine the slip of structural steel double-lap joints assembled with high-strength steel bolts when subjected to stresses in the design range and beyond. The joints were compared on the basis of the shearing stress on the bolts, the coefficient of friction and the slip, and the stress on the net cross-sectional area.

485. Structural Application of High Strength Bolts, by T. R. Higgins and E. J. Ruble. (ST) High-strength bolts as structural fasteners in field connections are increasingly popular because of the ease of installing them and their superiority to rivets in joints subject to severe fatigue loading. The paper describes examples of the use of such bolts. Extensive retraining of personnel is unnecessary; the over-all cost is similar to that for riveted joints.

486. A Strain Balance System for Analysis of Redundant Structures, by Oliver A. Baer. (ST) A method of analysis is presented which makes use of the fact that the displacements of certain points in redundant structures depend on the strains in more than one set of members. A Williot deflection diagram is used to indicate whether the assumed strains in all the members are consistent or what revision of assumed forces in the redundant members is necessary to make the forces more nearly correct.

487. Discussion of Proceedings-Separates 191, 196, 423. (CP)

488. Discussion of Proceedings-Separates 313, 343, 349, 430. (ST)

489. Surface-Water Supply for Irrigation in the Vermilion River Basin, Louisiana, by E. L. Hendricks. (HY) Surface-water problems in the Vermilion River basin are analyzed, based on data from an investigation (1949–1951) of the water resources of southwestern Louisiana. The total average water requirement, diversion requirement, and the necessity for a supplementary water supply to the Vermilion River are discussed.

490. Ground Water in the Vermilion River Basin, Louisiana, by Paul H. Jones. (HY) The paper describes the relation between surface and underground water conditions in the lower Vermilion River basin. Continued salt-water contamination from the river threatens the total ground-water supply of the southern part of southwestern Louisiana; the availability of water depends largely on how well salt-water intrusion is prevented.

491. Discussion of Proceedings-Separates 354, 361, 362, 366, 390, 413, 431, 432. (HY)

492. Waste Disposal at a Steel Plant: General Problems, by Ross Nebolsine. (SA) The Fairless Works of the United States Steel Corporation at Morrisville (Pa.) required comprehensive facilities for handling and treating 13 different types of industrial wastes, discharging from 44 different outlets and—at present—totaling over 80,000,000 gpd., but with provisions for ultimately treating 175,000,000 gpd. The solution of the problem is described in the paper and in the four succeeding papers comprising this symposium.

493. Waste Disposal at a Steel Plant: Treatment of Sheet and Tin Mill Wastes, by Hugh MacDougall. (SA) The sheet and tin mill section of the development discharges only a relatively small part of the total volume of the wastes produced by the Fairless Works. However, because of the varied nature of the wastes and the concentration of oils, acids, alkalis, and metal salts, a special plant was designed that would intercept and provide treatment for these wastes and recover some of them.

494. Waste Disposal at a Steel Plant: Treatment of Flue Dust Waste, by Angus D. Henderson and John J. Baffa. (SA) Gas produced by blast furnaces is washed in gas scrubbers to remove impurities. The water used for washing gas must be cleansed of this flue dust before discharge into the river. The nature and concentrations of flue dust in gas-washer effluents is noted, and the extensive facilities which have been provided at the Fairless Works for clarification of these wastes are described.

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495. Waste Disposal at a Steel Plant: Treatment of Sewage, by John J. Baffa. (SA) The design features of a trickling-filter plant to treat domestic sewage from a steel mill are described. A population of 9,000 persons is provided for, with an average-day, shift-flow rate of 957,000 gpd. The plant comprises a pumping station, a two-story primary tank, a dosing siphon, trickling filters, a humus tank, and chlorination facilities.

496. Hog Feeding: Report of a Subcommittee of the Committee on Refuse Collection and Disposal of the Sanitary Engineering Division. (SA) The nationwide epidemic (1952–1953) of vesicular exanthema, a swine disease, called attention to the health hazards of feeding raw garbage to swine and resulted in a marked change in the attitudes of public officials. Research and field demonstrations are needed to develop unobjectionable and profitable methods of preparing garbage and feeding techniques for hog farms.

497. Incineration: Report of a Subcommittee of the Committee on Refuse Collection and Disposal of the Sanitary Engineering Division. (SA) The report includes a a tabulation of fifty-three incinerator installations made during 1952 and 1953. Several problems in the design and operation of incinerators are discussed. Among these problems are measurement of refuse, stoking, stoking grates, residue, fly ash, charging buckets, over-fire air, and landscaping.

498. Garbage Reduction: Report of a Subcommittee of the Committee on Refuse Collection and Disposal of the Sanitary Engineering Division. (SA) The period from 1885 to 1910 represents the era during which the greatest number of reduction plants were constructed. Since that time, the use of this method of garbage disposal has declined steadily; it is not unreasonable to predict that this process will become a matter of history. Several of these earlier reduction processes are described briefly. A comparison is made between the relative productions of odors, and the economic feasibility of each production is evaluated.

499. Performance of Soils versus Chemical Properties, by C. Kinney Hancock. (HW) Some soils exhibit traffic-bearing characteristics contrary to those predicted from physical-test data. To reduce the economic loss resulting from the use or nonuse of such soils, the soil colloid silica-sesquioxide ratio is proposed as a supplementary index of roadbed performance. The relationship between chemical properties of soils and roadbed performance is simplified.

500. Expedient Geometry for the Design of Compound Highway Curves with Connection Spirals, by Robert D. Schacherl and George J. Berindoague. (HW) The principles of the proposed method of computing transition spirals which connect compound curves on highways have been applied to the horizontal alinement for the 310-mile Cochabamba-Santa Cruz highway in Bolivia. Illustrative examples, figures, and computation charts are included to clarify the method and expedite its adoption in engineering offices.

501. Discussion of Proceedings-Separates 190, 276, 351, 357. (HW)

502. Problems Encountered in Improving a Deep Water Harbor, by Harry Sugden. (WW) The problems encountered in improving or developing a fresh water stream into a deep water harbor are discussed in the paper. Specifically, the Savannah (Ga.) harbor is studied. Data were obtained in connection with studies of the effect of past improvements and of current problems and their possible solutions.

503. Development of the Delaware River for Commerce, by B. B. Talley. (WW) Improvement of navigation facilities on the Delaware River has been a primary factor in the industrial and economic growth of the region. Improvements now planned will add 60 miles of deep-water harbor capabilities and permit passage of the largest modern ore ships and tankers. Important engineering aspects of the proposed improvement are outlined.

504. Discussion of Proceedings-Separates 165, 259, 318. (WW)

505. Improving the Load Carrying Capacities of Subgrades, by Charles M. Noble. (CO) The rapid increase in wheel loads and tire pressures has stimulated the development of improved techniques and equipment for strengthening subgrades. Subgrades must be well drained and kept dry regardless of weather conditions. Illustrative of recent trends in subgrade design, the designs and methods utilized on a large eastern highway project are reviewed.

506. Discussion of Proceedings-Separates 226, 400. (CO)

507. A Steel Plant's Effect on Regional Planning and Development, by Russell VanNest Black. (CP) The significance of locating a primary steel plant in Lower Bucks County, Pennsylvania, was greatly magnified by the nature of the project and the sparsely-developed character of the territory. A chain reaction of development was set off; plans for highway improvements, zoning regulations, and land developments to meet the industrial expansion are gradually being put into operation.

508. Philadelphia Capital Budget and Program Procedures, by Charles A. Howland. (CP) The paper presents the problems, procedures, and results of advance annual programming of public improvements in Philadelphia, Pa., for a 6-year period. Legal requirements for preparing and adopting a capital program and budget are cited; it is shown how capital programming is coordinated with comprehensive planning and financing of public improvements. Cooperation of operating departments and citizen groups is described and the benefits of programming are noted.

509. History of the City Planning Division of the ASCE, by Harry W. Alexander. (CP) The paper consists of a résumé of the activities of the Division since its establishment in 1923. There are outlined the principal subjects discussed at meetings, activities of standing and special committees, growth in membership, and brief comments on the activities of the various chairmen.

510. Is Parking a Public Responsibility? by William R. B. Froehlich. (CP) The answer to the problem of public versus private parking responsibility depends on individual city conditions. Private operators are often at a disadvantage in acquiring conveniently located property; unreasonable rates may result from demand being greater than supply. A public agency evaluating the over-all parking situation should be able to intervene when private enterprise fails to meet the need.

511. Solving the Engineering Problems of Metropolitan Areas, by G. H. Herrold. (CP) To cope with the engineering problems that arise from the growth of cities and their suburbs, the "Standard Metropolitan Areas" established by the Bureau of the Census is discussed as a concept for integrating city and country. Minneapolis and St. Paul (in Minnesota) are cited as examples of the many units of government in one standard area.

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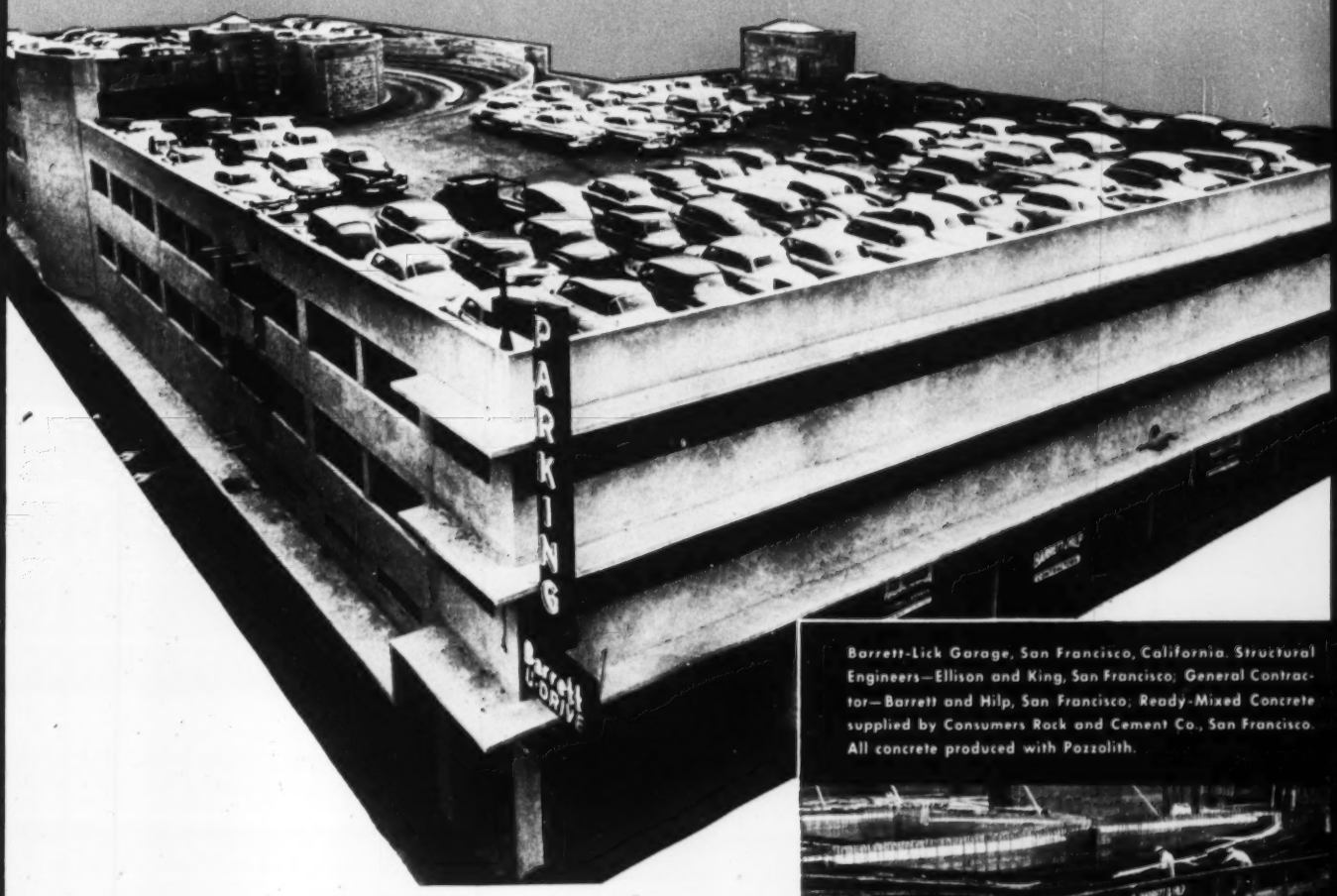

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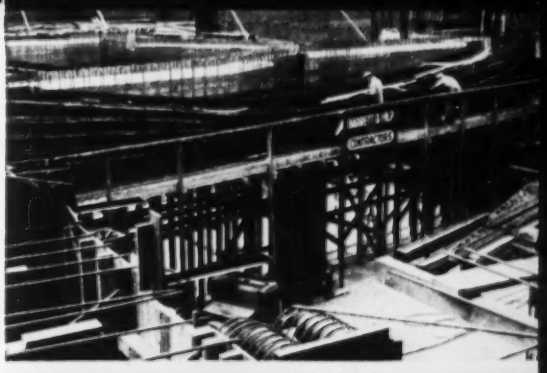

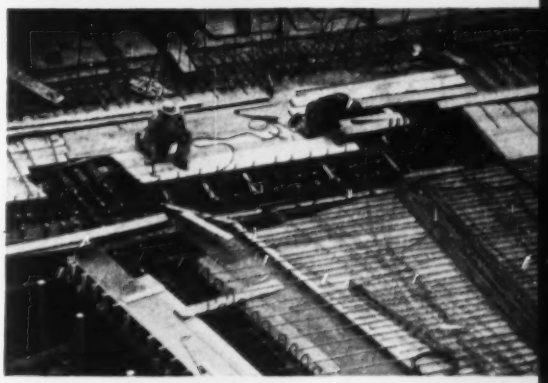

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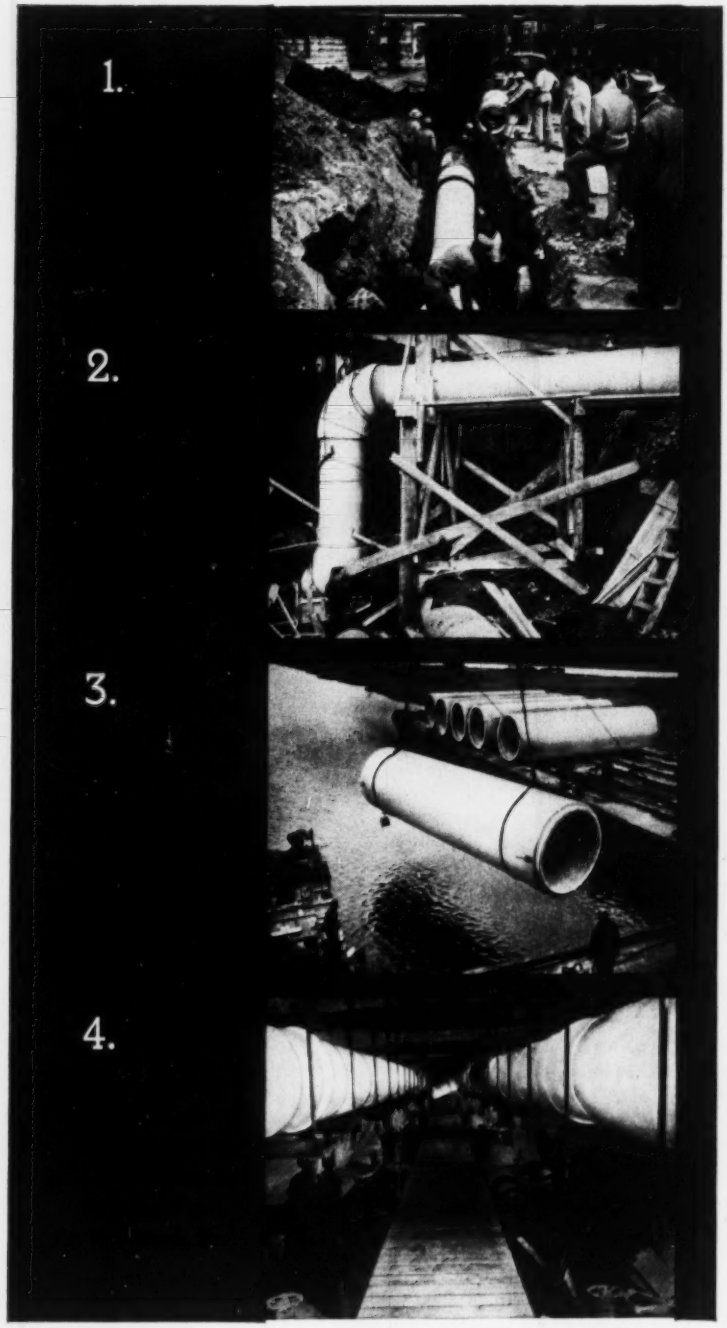

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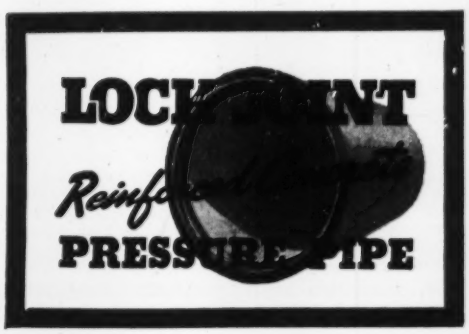
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